GROWING DATES IN THE UNITED STATES

UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURE INFORMATION BULLETIN NUMBER 207

PREPARED BY SCIENCE AND EDUCATION ADMINISTRATION

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By Roy W. Nixon and J. B. Carpenter

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PREFACE

Since the early 1960's, drastic changes have occurred in the availability and type of labor required for cultural operations in date palms. Use of seasonal labor, mostly from Mexico, was severely restricted, and people in the local labor force were often unwilling to work in date palms.

The agricultural engineering unit, Western Region, ARS, USDA, in cooperation with agricultural engineers of the University of California at Riverside, has been actively engaged in the mechanization of date culture. Improved man-positioning, date shaking, and transport equipment were developed to facilitate harvest. The multipurpose man-positioning equipment is adapted also to use in pruning leaves and fruit bunches, tying down of bunches, and bagging. Dual purpose ground-level equipment was developed for pollination and for pesticide application. An efficient pollen extractor was developed, which combines maximum removal of pollen from male flowers with reduced health hazards.

In revising this bulletin, the cultural operations described in previous revisions have been retained with such modifications as were required. Details on construction and use of mechanical equipment are in references cited in the text.

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GROWING DATES IN THE UNITED STATES

By R. W. NIXON, *SEA horticulturist (deceased)*, and J. B. CARPENTER, *SEA research plant pathologist*[1]

Dates are grown commercially in the Colorado Desert of southern California. Fruit production averaged 37 million pounds during 1969 to 1973. From 1968 to 1972, importations of dates, mostly from Iraq and Iran, averaged 28 million pounds annually (*126,127*).[2]

DATE-GROWING DISTRICTS IN THE UNITED STATES

In 1974, California had 4,503 acres of dates (*120*), of which 4,114 acres were in the Coachella Valley (fig. 1) of Riverside County and 389 acres were in Imperial County, principally in the Bard district. Although date culture is now restricted to these two areas in southern California, during the early part of the century, dates were grown at many sites in Arizona, California, and Texas (*53, 73, 94, 123*).

Prior to World War II, some dates were planted in most of the warmer areas of Arizona. In 1947, 550 acres were reported (*123*). Unfortunately, most of this acreage was in the Salt River Valley where summer rainfall is a serious drawback to commercial date production. Growers gradually became discouraged by repeated losses, occurring about one year out of two. At the same time, a large population increase in the Phoenix area brought pressure for homesites. As a result, nearly all the commercial plantings, which seemed to have promise for a while, were subdivided (*123*). The extension of early plantings in other localities where the climate is more favorable, such as the Colorado River Valley near Yuma, has been discouraged by economic conditions. In 1975, no data were available for date acreage in the State, but it is small, scattered, and relatively unimportant.

[1]SEA,USDA, U.S. Date and Citrus Station, 44-455 Clinton Street, Indio, Calif. 92201.

The assistance of J. H. Chesson, agricultural engineer, SEA, USDA, Riverside, Calif., with information on mechanization of date culture is sincerely acknowledged.

[2]Italic numbers in parentheses refer to Literature Cited, p. 56. Information on date culture in other principal date-growing countries may be obtained from various publications (*24, 27, 28, 32, 33, 38, 56, 64, 70, 74, 107, 125*). In addition, helpful articles on nearly all phases of the subject can be found in the reports of the Date Growers' Institute, Indio, Calif.

Seedling date palms are found in Texas, principally in the lower Rio Grande Valley and in certain localities between Laredo and San Antonio. In 1926, the Texas Agricultural Experiment Station, in cooperation with the U.S. Department of Agriculture (USDA), began an experimental program with imported varieties of dates, first at Weslaco in the lower Rio Grande Valley, a little later at Winter Haven near Carrizo Springs in the Winter Garden district. Offshoots were supplied from Indio

BN-8109-X

Figure 1.—A commercial date garden in the Coachella Valley, Calif., consisting of Deglet Noor palms about 15 years old. Note the paper covers over the bunches to protect the fruit from rain and the high borders with irrigation water between.

and from an importation from Iraq in 1929 (*137*). After World War II, however, the program was abandoned. The rainfall, beginning in late summer, is more than twice that of Salt River Valley, Ariz. A few people grow some date palms of early ripening sorts for home use.

Seedling date palms are also found in the other Gulf States from Texas to Florida, but climatic conditions seldom permit the fruit to ripen.

ORIGIN AND DEVELOPMENT OF DATE CULTURE

The date is one of the oldest cultivated tree crops (*102, 103*). The earliest known records in Iraq (Mesopotamia) show that its culture was probably already established as early as 3,000 B.C. The date palm has also been in Egypt since prehistoric times, but its culture did not become important there until somewhat later than in Iraq (*30*). From western Iran (Persia) across Arabia and North Africa, dates have long been a staple food for the native populations.

The date palm was introduced into the Western Hemisphere by the early Spanish missionaries, who planted date seeds around many of their missions. A few of these original palms or their offshoot survivors, dating from plantings in the late 18th or early 19th century, are still found in southern California and below the Mexican border (*62*). However, the damp climate of the coast, where most of the early missions were located, is not favorable to fruit production. It was not until seedlings planted in the hot interior valleys of California and southern Arizona in the middle of the 19th century began to bear that attention was attracted to the commercial possibilities of date culture.

In 1890, the USDA arranged for a small importation of date offshoots, but these later proved to be inferior (*124*). It was not until 1900 and the years immediately following that offshoots of the better varieties were obtained by Department plant explorers who visited the date-growing regions of Algeria, Tunisia, Egypt, and Iraq (*40*, *58*, *59*, *69*, *121*, *122*). The Department, in cooperation with the State agricultural experiment stations, made experimental plantings, first in the Salt River Valley, Ariz., and later in the Coachella Valley, Calif. These experiments attracted the attention of prospective date growers and led to several large commercial importations of offshoots during 1911-22 from Algeria, Iraq, and Egypt, and acreage plantings were made possible.

BOTANICAL RELATIONSHIPS OF THE DATE PALM

The date palm, one of the most important members of the family Palmaceae, is known botanically as *Phoenix dactylifera* L. The genus *Phoenix* is distinguished from other genera of pinnate-leaved palms by the

upward and lengthwise folding of the pinnae and the peculiarly furrowed seeds. There are about 12 species (*72*) all native to tropical or subtropical parts of Africa or southern Asia. Several of these are fairly well known as ornamentals, the most highly valued being *P. canariensis* Chabaud, the Canary Island palm, extensively used along driveways and in parks across the extreme southern part of the United States. Another species, *P.sylvestris* (L.) Roxb., is cultivated in India as a source of sugar. *P. dactylifera* is distinguished from these two species by the production of offshoots, or suckers, and from other species by its tall, columnar, relatively thick trunk (*13*). Close relationship among the species is indicated by the ease of cross-pollination and hybridization (*12,72*).

All species are dioecious, male (staminate) and female (pistillate) flowers being produced in clusters on separate palms in the axils of leaves of the previous year's growth (figs. 2 and 3). The inflorescence, or flower cluster, is a branched spadix and is enclosed before maturity in a protecting sheath, or spathe. Like other monocotyledons, the trunk lacks the cambium growth layer typical of fruit trees of the Temperate Zone and has only a single bud, or growing point. Leaves of the date palm are 10 to 20 feet long and have a normal life of 3 to 7 years. Old or dead leaves are not shed, but they are removed under cultivation.

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Figure 2.—Flower clusters of the date palm as they appear when the spathe first opens: *A*, Female; *B*, Male. (X about 1/6.)

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Figure 3.—Date flowers on strands removed from large flower clusters: *A*, Female; *B*, male. (X about 2.)

CLIMATIC REQUIREMENTS

For proper maturing of fruit, the date requires prolonged summer heat without rain or high humidity during the ripening period. The average daily maximum air temperatures from stations in several localities in the United States (*128*) where dates are grown are compared in table 1 with those in Basra, Iraq (*57*), and Touggourt, Algeria (*63*). Miami, Fla., is included because it is typical of districts favorable to palm growth but not to date production. Recent studies have been made in Algeria (*114*) on temperature in relation to quality of Deglet Noor dates.

At Indio, in the Coachella Valley, Calif., the maximum temperature frequently exceeds 110° F and has been as high as 123°. Date leaves are injured by prolonged temperatures of 20° or below (*83*), but such temperatures are rare in the districts where dates are produced commercially in the United States.

Since rain at any time from early summer through the harvest season is likely to cause some damage to the fruit, commercial date culture has been developed only in districts where there is almost no rain during that part of the year. Table 2 (*128*) shows that in all districts in the United States where date palms will grow, rain sometimes occurs during this critical period, but the danger of damage to the fruit is greater in some localities than in others. However, the amount of any particular rain is of less importance than the conditions under which it occurs. A light shower accompanied by prolonged periods of cloudy weather and high humidity may cause more damage than a heavy rain followed by clear weather and drying winds.

SOIL REQUIREMENTS

Dates are grown on a wide variety of soils. The maximum water-holding capacity consistent with good drainage is desirable. Coarse sand requires excessive fertilization and irrigation and permits rapid leaching of mineral nutrients unless underlain by more retentive soil of finer texture somewhere in the first 6 feet. On the other hand, good growth and production cannot be expected unless the soil takes water readily to a depth of 6 or 8 feet. Some of the finest date gardens in southern California are on deep sandy loams.

Although the date palm will grow in soils containing more alkali or salts than many other plants will tolerate, observations in the Southwest indicate that palm growth and fruit quality are reduced under very saline soil conditions. In view of the large investment required to bring a date garden into bearing and maintain it in profitable production, the best soil obtainable will be the cheapest in the long run.

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Table 1.—Average daily and annual maximum air temperatures at five subtropical stations in the United States as compared with those in Basra, Iraq, and Touggourt, Algeria

Station in—	Length of record	Average daily maximum temperatures												Average annual maximum temperature
		January	February	March	April	May	June	July	August	September	October	November	December	
	Years	° *F*	° *F*	° *F*	° *F*	° *F*	° *F*	° *F*	° *F*	° *F*	° *F*	° *F*	° *F*	° *F*
Miami, Fla.....	19	74.3	74.8	76.8	79.7	82.5	86.9	86.9	87.3	86.0	82.8	77.6	75.2	80.8
Carrizo Springs, Tex	8	66.5	73.5	78.7	85.9	91.3	19.1	99.1	99.2	93.4	85.0	74.0	65.5	84.0
Phoenix, Ariz	35	65.0	69.1	74.1	81.8	90.0	100.9	102.7	100.9	96.7	85.9	74.5	65.0	83.9
Yuma, Ariz	53	66.7	72.0	78.1	85.4	92.5	101.9	105.5	104.1	99.6	88.0	76.2	67.2	86.4
Indio, Calif	25	69.6	74.8	79.6	86.2	92.7	102.1	106.5	105.5	100.6	90.7	80.4	70.7	88.3
Basra, Iraq.....	19	60.0	65.2	73.7	84.0	94.3	100.6	104.4	104.9	101.3	90.6	77.0	64.0	84.9
Touggourt, Algeria..	15	62.6	67.1	73.0	82.2	90.1	99.0	106.3	104.2	96.8	84.2	71.2	63.3	83.4

Table 2.—Average number of rainy days and average annual rainfall at five subtropical stations in the United States

Station in—	Length of record	Average number of days with 0.01 inch or more of precipitation												Rainfall	
		January	February	March	April	May	June	July	August	September	October	November	December	Annual	Length of record	Average annual
	Years														*Years*	*Inches*
Miami, Fla.....	19	9	6	7	7	12	13	15	15	18	16	10	7	135	46	59.78
Carrizo Springs, Tex	8	2	3	3	3	5	3	3	2	4	3	3	2	36	9	19.80
Phoenix, Ariz	35	4	4	4	2	1	1	5	6	3	2	3	4	39	55	7.43
Yuma, Ariz	60	2	2	2	1	(1)	(1)	1	2	1	1	1	2	15	61	3.33
Indio, Calif	33	2	2	2	1	0	0	0	1	1	1	1	2	13	52	3.00

[1]Trace.

PROPAGATION BY SEEDS

Dates may be grown either from seeds or from offshoots. When grown from seeds, approximately half of the palms will be male and produce only pollen. No two seedling palms are alike, and few of them are likely to produce fruit of good quality. However, when a seedling palm appears outstanding in any way, it can be propagated by its offshoots, which will always reproduce the parent type. Then it becomes essentially a new variety or clone. Some new varieties originating in the date-producing districts of California and Arizona have been named, are being propagated, and may have promise for the future. However, it takes many years to prove their commercial value and to propagate sufficient offshoots for large plantings. In those parts of southern California and Arizona where the better imported varieties of dates can be grown, it is not desirable to plant seeds except for experimental purposes.

Where conditions are known to be unfavorable to date fruit production, as in Florida and elsewhere around the Gulf of Mexico, the planting of date seeds of varieties tolerant to rain is the most economical way of getting a few palms that may occasionally provide fruit for home use. Because the young plants are small and rather inconspicuous for the first 2 or 3 years, the mistake is often made of planting date seeds so close that bearing is delayed and subsequent handling made difficult.

Date seeds usually grow readily when planted in well-aerated soil at a depth of 1 to 2 inches after the weather warms up in the spring. Seeds may be planted either in nursery rows or directly in permanent or semipermanent locations. To insure a good stand, two or three seeds may be placed in each permanent location and all but one of the seedlings removed later. Unless the young palms are grown in pots, where they can be handled without much disturbance to the roots, it is better not to attempt to transplant them until after the second or third year. If the young palms are to be left in place until they can be culled out after flowering and fruiting, they should not be spaced closer than about 6 feet apart in the row. For best fruit production, each adult palm should be allowed a space equivalent to that used in commercial plantings, or about 30 by 30 feet.

PROPAGATION BY OFFSHOOTS

Rooting Offshoots

A date variety, whether male or female, can be propagated only by offshoots, which develop from axillary buds on the trunk chiefly during the early life of the palm. When, after 3 to 5 years of attachment to the parent palm, these offshoots have produced roots and have started to produce a second generation of offshoots, they are then ready to be

removed. To promote rooting, the base of the offshoot should be in contact with moist soil for at least a year before cutting. For offshoots slightly above the soil surface, this can be accomplished by mounding the soil. For high offshoots, soil may be held around the base by means of boxes, but unless very valuable these offshoots are more often allowed to become fully mature on the palm and then are placed in a nursery for rooting. The production of high offshoots is primarily a varietal character, but it appears also to be stimulated to some extent in a damp climate.

The size of the offshoot when ready for cutting will vary with the variety, commonly ranging from 40 to 100 pounds in weight and from 8 to 14 inches in maximum diameter. It is safer to leave an offshoot on the parent palm a little too long than to remove it before it is mature and well rooted. However, there will be less injury to the palm and better development of offshoots if each one is cut as it matures. In California and Arizona the best time to remove and transplant offshoots is after the soil begins to warm up in the late spring and early summer.

Pruning Offshoots

In general, no green leaves should be removed from an offshoot until it is cut from the parent palm, as the growth of an offshoot will be in proportion to its leaf area. However, when a palm is crowded with offshoots, the leaves on the smaller ones are sometimes cut back close to the bud to retard their growth until a few of the larger offshoots selected for removal first have been taken from the palm. Subsequently, the larger remaining offshoots may be selected for the next year's cutting and all their leaves retained until the offshoots are removed. When leaves interfere with cultivation, they may be tied up.

Removing Offshoots

The cutting of a date offshoot from the parent palm requires care and skill, which can be acquired only by experience. Whenever possible, the beginner is advised to learn the technique by watching and assisting a skilled operator. The soil is first dug away from the offshoots with a sharp, straight-blade shovel. A ball of earth, 2 or 3 inches thick, is left attached to the roots, but the connection is exposed on each side. Dry or sandy soil does not adhere readily to the roots, but the roots should not be cut closer than suggested, for, although most of the cut roots die, there is danger of injuring new roots just emerging. Irrigation several days before cutting makes it easier to dig and ball the offshoots.

The offshoot is cut from the parent palm by a specially designed chisel. This is a rectangular cutting blade made of the best highly tempered tool steel, which is welded to a tough iron handle. One side of the blade is flat and the other beveled so as to form three sharp cutting edges. A chisel of the following dimenions has been found convenient for general use: Blade, 4-1/2 inches wide, 9 inches long, and 1 inch thick; handle, 48 inches long and 1-1/4 inches thick.

Two men are required for the cutting operation. A skilled workman handles the chisel, and under his direction a second man drives the chisel with an 8- or 10-pound sledge hammer (fig. 4). If loose fiber and old leaf bases have been cut away, the operator can usually locate approximately the connection between the offshoot and the parent palm. The first cut is made to the side of the base of the offshoot close to the main trunk. The flat side of the chisel is put toward the offshoot and the beveled side toward the parent palm. The procedure will give a smooth cut on the offshoot and allow the beveled side to press away from the palm. In using these tools, the workmen must be especially careful to avoid injury.

After completion of a cut, the chisel is removed by working it up and down parallel to the cutting blade while exerting a steady outward pull. A single cut may sometimes sever the connection. Usually one or more cuts from each side are necessary. No attempt to pry the offshoot from the palm should be made before the connection is severed. The diameter of the offshoot connection varies in different varieties and to a much less extent in different offshoots of the same variety.

The offshoots may be pruned before cutting. If they are crowded on the palm, it may be desirable to cut off the lower leaves and tie the remaining ones close together in order to facilitate handling. However, some pruning is always necessary after cutting, and often all of it may be more conveniently done then. The old leaf stubs and lower leaves are cut off close to the fiber, the basal 2 to 4 feet of the offshoot being left bare of

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Figure 4.—Cutting a date offshoot, showing chisel and sledge hammer in use.

leaves. Ten or twelve leaves around the bud are retained and tied close together a few inches above the bud with heavy twine or wire. The terminal parts of these leaves extending beyond the tie are also cut off.

Care should be taken to prevent the roots from drying out between cutting and planting. Offshoots left any length of time in the field can be protected by throwing a little moist soil over the roots. Balling with wet sphagnum moss and burlap is often practiced with offshoots that are to be shipped some distance. Rough handling should be avoided, as it is possible for the bud and tender heart leaves to be damaged by being dropped or subjected to undue strain.

Planting Offshoots

Most varieties of dates are planted 30 by 30 feet apart. This spacing has generally given more satisfactory results than other spacings that have been tried. However, a variety like Khadrawy, which grows slowly and is a relatively small palm, can be planted 2 to 4 feet closer without undue crowding.

In most soils, the early growth of the offshoot will be better if the holes are prepared a few months before planting. They should be about 3 feet in diameter and 3 feet in depth. They should be filled with a mixture of topsoil and barnyard manure and subsequently irrigated several times to promote decomposition of the organic material. Well-rotted manure may be used in holes prepared and irrigated shortly before planting, but care should be taken to put the manure deep enough to allow a layer of soil at least 6 or 8 inches thick to be placed between the manure and the base of the offshoot. If not prepared in advance, the hole should be dug only deep enough to accommodate the offshoot; otherwise, the soil may settle after planting and lower the offshoot too much. A basin 6 to 12 inches deep and 4 to 6 feet across should be prepared around the planting location and the offshoot set in the center to the depth of its greatest diameter, usually about 14 to 20 inches, but never so deep that the water in the basin will reach the loose fiber near the bud (fig. 5). In planting, it is very important that the

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Figure 5.—A date offshoot after planting, wrapped with burlap to protect the leaves.

base of the offshoot be in contact with the soil at all times. To avoid the formation of air pockets, it is well at first to tamp in only enough moist topsoil to half fill the hole and then follow immediately with a light irrigation, during which the hole is filled in to the level of the basin and the soil carefully worked in around the base of the offshoot.

It is essential that the soil near the newly planted offshoot be kept moist at all times by light, frequent irrigations. Inspection should be made often during the first few weeks to see that the surface soil does not dry and shrink away from the offshoot. To avoid this, a mulch of hay or straw is of considerable value. The frequency of irrigation will depend somewhat on the soil type. During the first summer, daily irrigations may be desirable on very sandy soils. Every second or third day will not be too often on most soils, but on very heavy soils once a week may be sufficient. Although the frequency of irrigation may be reduced after the offshoot is well established, even in the second year it is desirable to apply water more often than is necessary for old palms. Special care should be taken during the first few years after planting to prevent the establishment of grass sod, which often will retard the growth of newly planted offshoots.

For protection against sun and wind during the first summer and against cold the following winter, the newly planted offshoot should be wrapped with burlap or with a layer of leafy material such as cornstalks or date leaves. The top should be left open so that new growth may push out (fig. 5).

The basins or borders used for irrigation during the first few years after planting should be enlarged from year to year to approximately the spread of the palm leaves. As the palms begin to come into bearing and after most of the offshoots have been removed, either the basin or the furrow method of irrigation may be employed, depending on the type of soil and the slope of the land.

INTERPLANTING

Dates are sometimes interplanted with citrus, but the combination is often unsatisfactory. Interplanting may be justified for protection of citrus from cold damage and from sunburn. If the two crops together do not have at least as much space as each planted separately would require, yields of both are almost certain to be reduced. Serious checking, blacknose, and rot of Deglet Noor fruit often result from increased humidity when the palms are not high enough, so that the bunches hang well above the tops of the interplanted trees. With varieties whose fruit is less susceptible to such damage there may be less objection on this score. In any event, it is preferable to plant citrus and dates in separate rows, with enough space between so that each may be given different irrigation and other cultural treatment.

Wherever there is considerable danger of rain damage to dates during the ripening season, ample space between palms is important for free air movement and adequate sunlight. Under such conditions, conventional orchard arrangements are less desirable than planting in single or double rows separated by 60 feet or more. With this wide spacing, no plants are deprived of sufficient sunlight, and the better ventilation of the palms will reduce loss from fruit rot. Between the rows of date palms, various low-growing crops may be planted. This method has long been employed in certain localities near the Mediterranean coast, such as Gabes in Tunisia and Elche in Spain, where date palms are regularly planted in one or two rows around rectangular garden plots of annuals or low-growing fruit crops.

SOIL MANAGEMENT

Irrigation

Careful attention to irrigation in order to maintain good palm growth and high yields of fruit of the best quality cannot be stressed too much (*2,45, 71, 100, 105.*) The frequency of irrigation will depend on soil texture and weather conditions. Bearing gardens on the lighter soils are usually irrigated every 7 to 14 days during midsummer and every 20 to 30 days during winter. On the heavier soils irrigations are somewhat less frequent. In the Bard district, where a moving water table is at a depth of 4 to 8 feet, as few as four to six irrigations appear to be adequate. In Coachella Valley, however, a water table as high as 6 feet usually results in salt accumulation that reduces yields unless tile drains are installed. In any case, soils should be kept moist to a depth of 7 to 8 feet. *The grower should make sure by means of a soil auger, tube, or shovel that the water is actually getting to the depths desired in all parts of the planting* . Some of the difficulties often encountered in getting water down to the proper depth should be mentioned.

Downward movement of irrigation water may be retarded by one or more layers of silt or silty clay. Frequently this condition occurs in only one or two small areas within a garden. Even when water sufficient for a row of palms is applied, rapid downward movement in sandy areas without silt layers may drain the water away from the area of slow penetration before the lower soil becomes wet. Basin flooding in the area of slow penetration usually helps to overcome this difficulty.

In coarse, sandy soils uneven distribution of water may result from such a rapid downward movement near the water outlet that it does not leave enough water to reach the palms at the lower end of the run. Reducing the distance of waterflow to 300 feet or less by installing additional pipelines and headstands is frequently desirable. Applying a larger stream of water down fewer rows of furrows is effective, but usually this requires more attention by the irrigator.

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Where the land is not properly leveled before planting, the water may flow rapidly to the lower end of the row and not remain in contact with the upper and middle parts of the row long enough for adequate penetration. Where the slope is too steep for moderate regrading, a smaller stream of water in each furrow or row usually provides better distribution. Cross borders also may be used to hold water longer on areas of slower penetration. Best results have been obtained when the land was nearly level before planting.

When cover crops are grown or there is considerable weed growth, such as bermudagrass, provision for more water per irrigation or more frequent irrigations will be necessary. If adequate soil moisture cannot be maintained under such conditions, cultivation to reduce or prevent further covercrop or weed development is advisable.

Insufficient moisture at lower depths throughout much of the garden is good evidence that insufficient water is being applied. Often the frequency and amount of irrigation are not increased soon enough in the spring, and the increased requirements of the palm during warm weather make it difficult to supply enough water to reach the lower depths. When moisture becomes deficient in the subsoil, it may be necessary to irrigate two or three times in rapid succession and to apply a total of as much as 8 to 12 acre-inches of water in order to wet the soil to a depth of 7 to 8 feet. Once the soil has been wet to the desired depth, 4 to 6 acre-inches of water per irrigation may be sufficient, depending on the period between irrigations, the soil texture, and the efficiency of distribution.

Many growers like to reduce or withhold irrigation during the harvest season. This may be done to make the garden accessible at all times, to promote the drying of some soft dates, or to reduce fruit drop in humid weather. With the Deglet Noor and Khadrawy varieties, if ample soil moisture is provided up to early August for palms in full production on a deep soil of high water-holding capacity, subsequent irrigations may be greatly reduced or omitted entirely for 2 or 3 months or even longer without reduction in yield or quantity of fruit (*44, 48, 49*).

Although these results suggest that on good soils more water than is actually required for full production may sometimes be applied, unnecessarily long intervals between irrigations are not recommended as a cultural practice because of difficulties in salt removal and soil management when irrigation is resumed. Also, all varieties apparently cannot be handled in the same manner, for the Halawy date tends to develop some shrivel unless more water is applied during ripening than seems necessary for other varieties (*46, 85, 123*). Whatever irrigation program is followed during the fall and winter, it is important that there be ample soil moisture available for palm growth during the spring and early summer, for a deficiency then is likely not only to hasten the ripening of the fruit but also to reduce its size and quality (*2*).

Experience in the Coachella Valley

indicates that on light soils not less than 9 to 12 acre-feet of water per year is necessary for palms in full production and that from 12 to 18 acre-inches per month is required during the summer. On heavy soils in other districts, half this amount may be enough. Sufficient water must be applied to make up for evaporation loss from the soil surface, to supply palm requirements, and to prevent an accumulation in the root zone of the salts contained in the irrigation water. Additional water must be provided to take care of interplantings or cover crops.

The date palm is remarkably salt tolerant (*50*), but if there is reason to suspect a heavy accumulation of salts in the soil, apply sufficient water to leach the salts out of the principal root zone of the palm (usually the first 6 or 7 feet of soil) and move them down to a lower depth. This may be done best by two or three heavy irrigations in rapid succession sometime during the winter. The use of irrigation water containing a high proportion of sodium may in time produce a soil structure unfavorable to penetration (*68*). Under such conditions, it may be beneficial to apply 1 to 3 tons of gypsum per acre (*66*). It should be worked into the soil before the heavy irrigation to promote leaching. If the soil is calcareous, from 400 to 1,200 pounds of sulfur per acre may be substituted for the gypsum, but it should be worked into the soil several months before the heavy irrigation for leaching. During that interval, the soil should be given one or more light preliminary irrigations (*67*). Winter cover crops are particularly valuable in improving water penetration under circumstances of this kind.

The grower should determine from time to time the amount of water that is actually being applied at each irrigation. The following formulas may be used to compute the depth of water applied to a given acreage in a given length of time:

$$\frac{\text{Cubic feet per second} \times \text{hours}}{\text{acres}} = \text{acre-inches per acre, or average depth in inches.}$$

$$\frac{\text{Southern California miner's inches} \times \text{hours}}{50 \times \text{acres}} = \text{acre-inches per acre, or average depth in inches.}$$

$$\frac{\text{Arizona and California statute miner's inches} \times \text{hours}}{40 \times \text{acres}} = \text{acre-inches per acre, or average depth in inches.}$$

These formulas are based on the fact that a flow of 1 cubic foot per second, or 450 gallons per minute, approximates 1 acre-inch per hour, or 50 southern California miner's inches, or 40 Arizona and California statute miner's inches. Most wells in southern California are rated in southern California miner's inches. Use of drip irrigation has just begun, and local experience is very limited. This method of irrigation is widely used on date palms in Israel (*108*).

Fertilization, Cover Crops, and Cultivation

Fertilization has generally been found necessary to maintain the quantity and quality of production,

but there are few experimental data bearing on the kind and quantity of fertilizer or on the time of its application. Since a palm may make better growth in a good soil with little or no fertilization than in a poor soil with heavy fertilization, any fertilization program must be adapted to the soil type in each garden. However, the inexperienced grower will make no mistake if he follows the practices of the best date growers and modifies his procedure, when a change seems desirable, by varying the treatment on a few palms and then comparing their appearance and fruit production with those of similar palms in the same garden.

Animal manures are widely used in the better date gardens of the Middle East and North Africa. In California and Arizona, barnyard manure is applied at the rate of 5 to 15 tons per acre. Steer manure is preferred because of its relatively higher nitrogen content (about 2 percent) as compared with that of cow or horse manure (0.5 to 1 percent). Chicken manure, with a still higher nitrogen content (3 to 5 percent), is being used when available. Manure is usually applied in the late fall or winter. If a winter cover crop is grown, manure is usually applied in the spring after the cover crop has been turned under.

Inorganic nitrogen in its various forms is also often used in date gardens in California. The amount applied should be determined on the basis of whether it is used alone or in combination with manure or cover crops. Studies thus far indicate that the total application of 4 to 6 pounds of actual nitrogen per palm from all sources is adequate on most soils in the Coachella Valley (*47*). More than this amoūnt may be needed on light sands because of excessive leaching. Under such conditions it may be desirable to divide the nitrogen into two or three applications during the growing season.

On most soils in arid regions, tree crops have failed to respond to applications of potash and phosphorus. However, fertilizers that improve cover-crop growth probably indirectly improve the growth of the date palm. Sometimes the cover crop may benefit from applying some form of phosphorus, such as triple superphosphate, at the rate of about 200 pounds per acre. However, it is not advisable to apply phosphate year after year because of possible harmful accumulations in the soil.

Winter cover crops of sourclover or sweetclover or other legumes are often grown while the palms are young. Hubam sweetclover planted in the fall has given particularly good results in date gardens in the Coachella Valley. On good soil, such an annual cover crop may supply all the nitrogen required by young palms for several years. Turning under a cover crop not only adds organic matter that decomposes readily and releases nutrients but also promotes better water penetration. Summer cover crops, such as sesbania and cowpeas, have been occasionally tried but are not generally used because of the additional water required during hot weather. After palms, spaced 30 by 30 feet, are 12 to 15 years old and have attained their maximum leaf spread, the shade beneath them is

unfavorable for the growth of any of the cover crops named and usually none are planted.

The old leaf and fruitstalk prunings are returned to the soil by some growers, who use mechanical choppers to cut them into small pieces. Analyses have shown that the prunings from an average garden of mature Deglet Noor palms contain more organic matter but less nitrogen than the average cover crop of sourclover (*39*).

Cultivation is commonly restricted to turning under cover crops or weeds and to preparing the land for irrigation.

PRUNING

Considerable evidence (*84, 86*) indicates that, other conditions being equal, the bearing capacity of a date palm is in proportion to the number of green leaves that it carries. An insufficient number of leaves in proportion to the amount of fruit results in low-quality fruit during the current season and fewer inflorescences the following spring. Therefore, it is desirable to retain all good green leaves unless there is some definite reason for removing them.

Removal of a few green leaves is justified under certain conditions. Some may have to be removed so that bags or covers may be placed over the fruit bunches. At least with the Deglet Noor variety, some palms between 10 and 20 years old under favorable growing conditions and not damaged by drought or low temperatures have been found (*88*) to retain more leaves than are needed for fruit production (fig. 6). As many as 180 green leaves have been counted on a single palm unpruned for 6 years. When this many leaves are retained, a considerable number will be below the fruit bunches. In certain localities, these leaves may increase the percentage of fruit affected with checking and blacknose and of fruit in the dry grades. These excess lower leaves apparently increase the relative humidity around the fruit bunches in midsummer wen checking occurs. Later, when the harvest begins, these leaves probably compete with the fruit for water, especially under the usual practice of reducing the amount of irrigation water applied during harvest. Under such conditions, it is desirable to remove some of the lower leaves in order to improve the fruit quality. With the Deglet Noor, which has long fruitstalks, removing the leaves up to about the point where the lower ends of most fruit bunches are exposed has proved satisfactory on palms in full bearing (figs. 7 and 8).

With varieties that have short fruitstalks, such as Halawy and Khadrawy, removing green leaves below the fruit bunches will reduce the bearing capacity of the palm. When it is desirable to reduce the number of green leaves, there should be no reduction in the quality of fruit during the current season or in the number of flower clusters produced

the following year if precautions are taken to maintain an adequate leaf-bunch ratio by reducing the number of fruit bunches if necessary. (See p. 27). If this pruning is done in June, the bunches will be better ventilated

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Figure 6.—A 12-year-old Deglet Noor palm with 166 green leaves. The fruit bunches are almost completely hidden by leaves several feet below. These lower leaves tend to increase the amount of blacknose.

during July and early August when most of the checking occurs, and usually the number of leaves will be adequate during the period between crops when the food reserves of the palm are being built up (*6*).

When Deglet Noor palms are over 20 years old, they seldom retain

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Figure 7.—The Deglet Noor palm shown in figure 6 after the number of leaves had been reduced to 120 by pruning off most of those below the lower ends of the lowest fruit bunches.

leaves below the mature fruit bunches; pruning should be confined to removing dead or dying leaves.

Dead or partly dead leaves may be removed at any convenient time, but because of greater ease in cutting it is usually preferable to remove them before the base becomes hard and dry. Occasionally, during a severe freeze, varying proportions of the

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Figure 8.—The Deglet Noor palm shown in figure 7 after the number of leaves had been reduced to 88 by pruning off enough to clear the tops of the fruit bunches. Such severe pruning tends to lower the bearing capacity of the palm and usually results in a light crop the following year unless the number of bunches is proportionately reduced.

green tissue on all the leaves on a palm may be killed. When the leaf area is drastically reduced in this way, it is desirable to retain all leaves with any remaining green tissue (*82*).

Sometime during the winter, the spines are removed from all leaves of the previous year's growth to facilitate pollination and subsequent handling of fruit bunches. A sharp pruning knife with a long, curved blade mounted on a handle 1 foot or more long is most frequently used for this work (fig. 9).

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Figure 9.—Removing spines from date leaves.

POLLINATION

Hand Pollination

Date palms are dioecious; that is, the male flowers that produce the pollen and the female flowers that produce the fruit are borne on separate palms. For commercial fruit production, the female flowers must be pollinated by hand. The most common method of pollination is to cut the strands of male flowers from a freshly opened male inflorescence and invert two or three of them between the strands of the female flower cluster during the first 2 or 3 days after it has opened (fig. 10). Twine is tied around the pollinated cluster 2 or 3 inches from the outer end to hold the male flowers in place and to prevent the strands of the female cluster from becoming entangled as the cluster pushes out between the leaves. To provide for the expansion of the cluster as the fruit develops, the twine is commonly tied in a slipknot with the free end long enough to permit later adjustment to the maximum size of the fruit bunch.

When male flowers are held for a few days before being used, they begin to dry and shatter, and it is then more economical to use dried pollen. It is generally applied by dusting it on cotton and placing one or two pieces of the cotton about the size of a walnut between the strands of the female cluster. In addition to the cotton, a few puffs of dry, sifted pollen are sometimes applied with a small manual insecticide duster similar to that known as a "puffer" in the poultry industry. With careful pollination, from 50 to 80 percent of the flowers will usually set fruit, which is sufficient for a full crop.

Most of the pollination in southern

BN-8103-X

Figure 10.—Pollinating date flowers: *A*, Strands of male flowers being placed in the center of the female cluster; *B*, freshly opened spathe ready for pollination; *C*, flower cluster after pollination. Twine is tied around the strands to hold the male flowers in place and to prevent tangling in the leaves. The tips of all strands in the female cluster were cut back at the time of pollinating as the first operation of fruit thinning.

California is done during March and April. A few flowers open earlier and a few later, depending on the season and the variety.

Pollination during periods of low temperatures early in the season is associated with poor sets of fruit on the flower clusters pollinated then (*22*). Under such conditions, the sets may be improved by placing bags over the flower clusters at the time of pollination (*106*). Long paper bags of the type used for enclosing bottles or french bread are satisfactory and should be fastened in some manner to prevent the wind from blowing them off. They may be removed after about 2 weeks or left on until the fruit bunches are tied down. No damage has been observed from using such bags.

Mechanical Pollination

Mechanical pollination of palms is performed in many orchards with a ground-level duster (*99*) capable of servicing 60 to 80 acres per season (fig. 11). The operator stands on a variable height platform, capable of 15 feet of vertical movement to accommodate tree height, and directs the pollen delivery tube near the bloom area of each palm. The duster is pulled along one side of a tree row and then returns on the opposite side to finish the pollination cycle.

For good fruit set, pollen must be applied to the blooms at 4 to 7 day intervals during the flowering season. If bunches are properly thinned, about 1.5 quarts of pollen, diluted with wheat flour, provide sufficient pollen for one acre of palms per season when applied weekly. When circumstances permit, application of pollen to alternate sides of the palm at 4 to 7 day intervals, which provides some overlapping of pollination, has shown more reliable results than full-tree application at one time, especially in seasons of below normal temperatures (*22*). Fruit set following use of the palm duster method is usually poorer than that following hand pollination, but yields and fruit quality are about equal as a result of decreased thinning of the duster-pollinated bunches.

Handling and Storing Pollen

Male flower clusters should be cut early in the morning, as soon as possible after the spathe breaks, to prevent wind or bees from causing loss of pollen. Bags placed over the spathes before they open are occasionally used to conserve pollen and avoid loss when the clusters cannot be cut daily. In the Middle East and North Africa, it is a common practice to cut the male spathe before it opens, but this procedure cannot be entirely recommended, for with the miscellaneous seedling males that are

PN-5394

Figure 11.—Palm duster, showing physical arrangement of equipment.

being used in the Southwest it is not always easy to make sure of the maturity of the inflorescence. However, the grower who becomes familiar with his best male palms will often be able with a little experience to judge the maturity of the unopened inflorescence. Usually, when the middle or lower part of the spathe is pressed between the thumb and forefinger, a crackling noise will be produced if the flowers within are mature. The spathe can then be cut and carried to the storage room, and the flowers can be removed to dry.

As freshly opened flowers contain a great deal of moisture, it is very important, if they are not to be used immediately, to dry them promptly. Otherwise, molds develop and destroy the pollen. A simple way of handling small lots of pollen is to cut off the strands and spread them in a thin layer on paper in shallow trays. For handling large quantities of pollen, screen-wire shelves or trays with screen-wire bottoms will be found convenient. A container beneath will catch the dry pollen that falls from the flowers. The flowers turn dark in a few days, but the pollen remains good.

An efficient mechanical pollen collector is now being used commercially (fig. 12); however, the details of this collector became available too late for inclusion under Literature Cited.[3] This equipment can handle 300 to 450 blooms per hour and removes about 40 percent more pollen than manual extraction methods. The viability and longevity of pollen are unaffected by mechanical extraction.

In drying and storing pollen, high temperatures should be avoided. If pollen is put in containers under glass and exposed to direct sunlight or is placed near a hot stove, it soon deteriorates and loses its viability (*51*). On the other hand, if held in a dry room at moderate temperatures, pollen will keep satisfactorily during the pollination season, which is 2 or 3 months. Pollen held over from one season to the next under such conditions has been found nonviable in numerous tests. However, pollen can be carried over to the next season if well dried, placed in an airtight container, and held in cold storage. A household refrigerator at about 40° F has proved satisfactory. Somewhat lower temperatures under conditions less subject to fluctuation are probably safer. To insure keeping the pollen dry, it may be placed in an open jar within a larger airtight container, in the bottom of which are kilndried lumps of calcium chloride (anhydrous). About 1 pound of calcium chloride should be adequate for each 5 pounds of pollen (*3*).

Selection of Male Palms

Formerly, seedling male palms were used rather indiscriminately, but growers are now beginning to realize the value of selection. There is an increasing tendency to purchase male offshoots rather than attempt to grow the palms from seed. One good male should furnish pollen sufficient for 50 or more female palms. The owner of seedling male palms should keep a

[3]Burkner, P.F., and Perkins, R.M. Mechanical Extraction of Date Pollen. Dates Growers' Inst. Rpt. 52: 3-7. 1975.

record of all that are considered good enough for further propagation and check their annual performance with regard to the following points, which will enable a prospective purchaser of offshoots to evaluate a given selection.

Time of blooming.—Obviously, if fresh pollen is to be used, the male palms must bloom as early as the

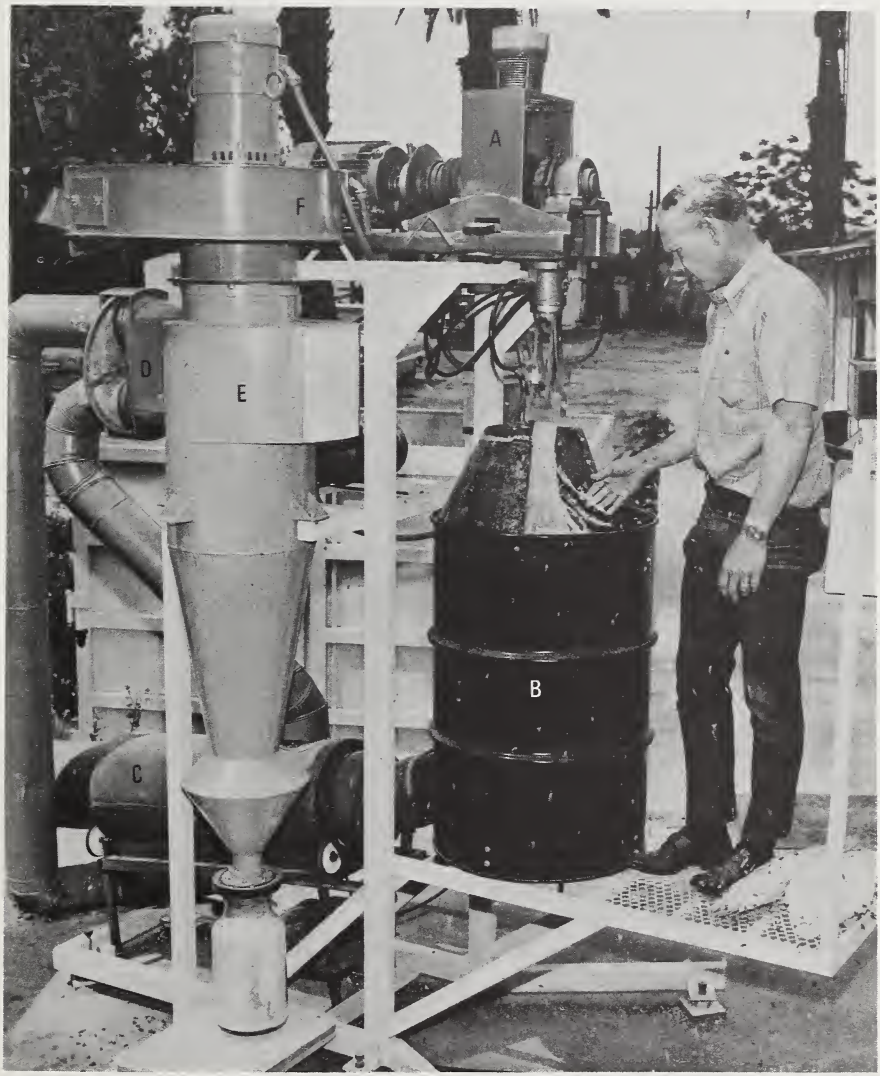

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Figure 12.—Commercial model of pollen extraction and collection system. Components include: *A*, Vertical shaker assembly; *B*, collection barrel; *C*, cylindrical screen tumbler; *D*, rotating screen disk assembly; *E*, cyclone separator; and *F*, suction fan assembly.

female palms. However, unless male palms are grown under the same favorable cultural conditions as the fruiting palms, they cannot be expected to flower and produce normally. Male palms are often crowded in fence rows and not given sufficient irrigation. Palms will flower earlier if planted on the south side of the garden or where there is maximum exposure to sunlight.

Number and size of flower clusters.—With more and larger inflorescences, fewer male palms will be required.

Flowers and pollen .—Flowers that tend to adhere to the strands without shedding easily are to be preferred, especially if the fresh flowers are to be used in pollination. The pollen will be better conserved if the petals are not wide open when the spathe first splits. The flowers should contain abundant pollen.

Compatibility.—In some varieties, a better set of fruit will be produced by pollen from some males than by that from others, apparently a matter of compatibility between male and female varieties. The prospective purchaser of male offshoots should know that the pollen in question has been used satisfactorily on the varieties he is growing.

Metaxenia, or the direct effect of pollen on the fruit.—Within certain limits the pollen used affects the size of the fruit and seed and the time of ripening (*76, 80, 81,*). As the size of the fruit is affected to a much greater extent by fruit thinning, generally practiced in commercial date culture, the effect of pollen on size is not of such immediate importance.

The changes in time of ripening that may result from the use of different pollens are not likely to be more than a few days where fruit ripens early, but they may be as much as several weeks where it ripens late because of the retarding effect of cool weather on ripening. In most localities within the warmer desert areas best suited to date culture, the grower need not be much concerned about the effect of pollen on time of ripening. However, in a few localities the late ripening of late varieties has been somewhat of a problem, and pollen causing earlier ripening has been used to considerable advantage. For example, in one Deglet Noor garden where the fruit was not all harvested until March 15 with the pollen generally used, applying a different pollen resulted in completing the harvest by the end of December (*135*). In marginal date districts, where there is usually insufficient summer heat for the proper maturation of fruit, the use of pollen causing earlier ripening has in a number of instances resulted in the ripening of fruit where it had never before reached maturity. Pollens from several Fard seedling males have produced this earlier ripening. Whether the crop would be benefited by earlier ripening in any particular case can be determined only by tests in which the pollen already in use is compared with one known to produce early ripening.

FRUIT THINNING

Fruit thinning is necessary (1) to increase the size, improve the quality, and prevent delayed ripening of the dates; (2) to reduce the weight and compactness of the fruit bunches; and (3) to insure adequate flowering the following year (*95*). Since the fruit may be thinned either by reducing the number of fruits per bunch (bunch thinning) or by reducing the number of bunches per palm (bunch removal) and since in commercial practice both operations are employed, it is necessary to give special attention to each of them.

Bunch Thinning

Every bunch should be thinned by removing not less than one-half and not more than three-fourths of the total number of flowers or fruits that it carries under normal conditions. A bunch may be thinned by reducing either the number of fruits per strand or the number of strands. It is generally desirable to use both methods in proportions, depending on the variety and on other considerations. With the Deglet Noor and other long-strand varieties (figs. 13 and 14), the tips of all strands should be cut back enough to remove about one-third or slightly more of the total number of flowers or fruits. In addition, entire strands should be cut out from the center of the bunch, enough to remove from about one-third of the total number on most bunches to about one-half on very large bunches. On mature Déglet Noor palms, bunches thinned in this way will normally carry at maturity from 20 to 35 dates per strand on 30 to 50 strands per bunch, and the ripe fruit picked per bunch will vary from 15 to 25 pounds, depending on the size of the cluster before thinning, the percentage of fruit set, and the amount of thinning as determined by other considerations. (See p. 29).

Varieties like Halawy (figs. 15 and 16) and Khadrawy have shorter, more numerous strands than Deglet Noor, and consequently less should be cut from the tips and more entire strands removed from the center of the bunch. In such varieties, very satisfactory results have been obtained by cutting back the tips of strands only enough to even up the end of the bunch, removing about one-tenth to one-sixth of the total number of flowers or fruits in this way, and cutting out entirely about one-half or slightly more of the total number of strands from the center of the bunch. Under some conditions, it may be preferable to omit cutting back the tips and to do all the thinning by cutting out center strands up to about two-thirds of the total number. Such thinning is usually desirable when spreader rings are used in centers of bunches as is done in some localities where damp weather prevails during ripening.

Instead of cutting back strands, a few growers of fancy soft dates prefer to remove a certain proportion of flowers or fruits from the strands.

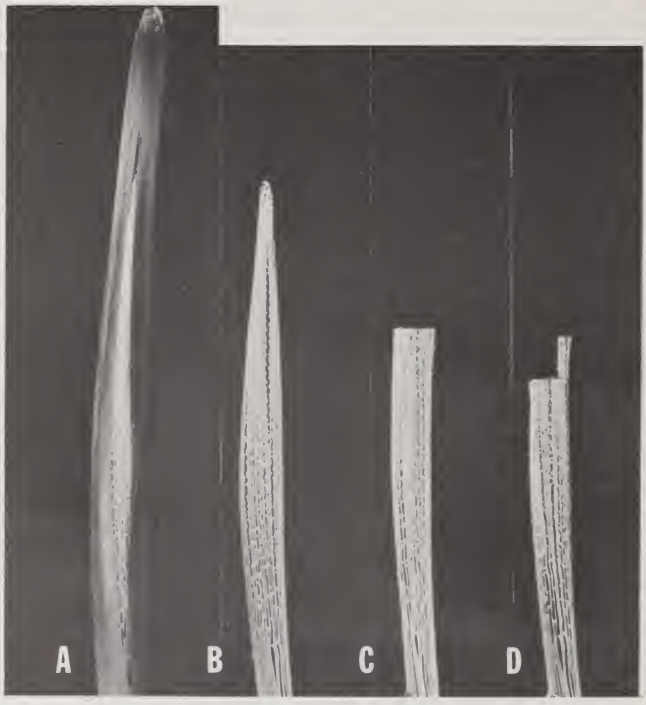

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Figure 13.—First step in bunch thinning long-strand varieties of dates (Deglet Noor) at the time of pollination: *A*, Flower cluster with spathe breaking, indicating maturity; *B*, flower cluster after enveloping spathe has been cut away; *C*, flower cluster with tips of all strands cut back before pollination; *D*, flower cluster showing moderate cutting back (long strands), which removes about one-third of the flowers, and heavy cutting back (shorter strands), which removes about one-half of the flowers. (X about 1/12.)

This method reduces crowding of fruits on the strands, but it is not much used because of the time and expense involved, except with very large dates such as Medjool (*90, 92*).

For maximum effect on size of fruit, strands should be cut back at the time of pollination (fig. 13). Cutting out center strands can be done at the time of pollination with some of the earlier bunches of the long-strand varieties, but usually this operation must wait until the cluster has emerged farther. A few growers complete the thinning of early bunches when pollinating the later ones. A more conservative practice is to wait 6 or 8 weeks until the set can be determined, when bunches of more uniform size can be obtained by removing fewer strands if the set is poor and vice versa. Where mechanical pollination is used, thinning is delayed until the bunches are tied down.

The exact method and amount of bunch thinning must be determined by the grower after due consideration is given to the variety, relative importance of size in grade, local

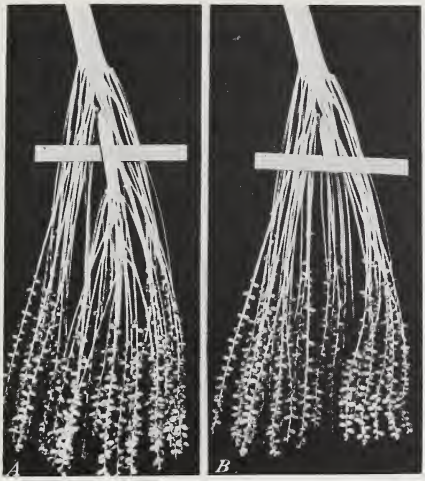

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Figure 14.—Second step in bunch thinning long-strand varieties of dates (Deglet Noor): *A*, Bunch of dates cut back 6 weeks previously, as shown in figure 11; strands in front of ruler must be entirely removed to prevent undue crowding of fruit; *B*, same bunch after one-third of the strands have been removed by a single cut. (X about 1/16.)

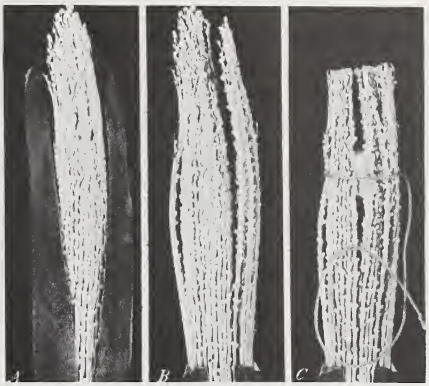

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Figure 15.—First step in bunch thinning short-strand varieties of dates (Halawy) at the time of pollination: *A*, Flower cluster just emerging from spathe; *B*, flower cluster with spathe cut away; *C*, flower cluster with just enough cut from the tips of the strands to remove about 15 percent of the flowers. Under some conditions it may be preferable to omit this and do all thinning by removing entire strands from the center. In *C*, note the cotton used to apply pollen and the twine around the strands to hold the cotton in place. (X about 1/8.)

weather conditions, and the effect on the fruit to be expected from different degrees of thinning by different methods.

Studies (*84, 85, 91, 96*) have brought out the following facts, which should be considered in determining the method and amount of bunch thinning:

- Any method of reducing the number of fruits per bunch will increase the size and up to a certain point improve the quality.

- To increase the size, reducing the number of fruits per strand is slightly more effective (5 to 10 percent) than reducing the number of strands, but cutting back strands increases the susceptibility of fruit to checking, to blacknose (fig. 17), and, particularly in some of the softer varieties, to shrivel of ripe fruit much more than does a comparable amount of thinning by cutting out strands.

- Overthinning increases puffiness and blistering (separation of skin and flesh).

- Slightly larger fruits are produced on the outside strands than are produced on the inside ones. The larger the bunch, the more fruit it can carry satisfactorily.

- The earlier thinning is done, the more effective it is in increasing size. In periods of damp weather during ripening more trouble is likely from

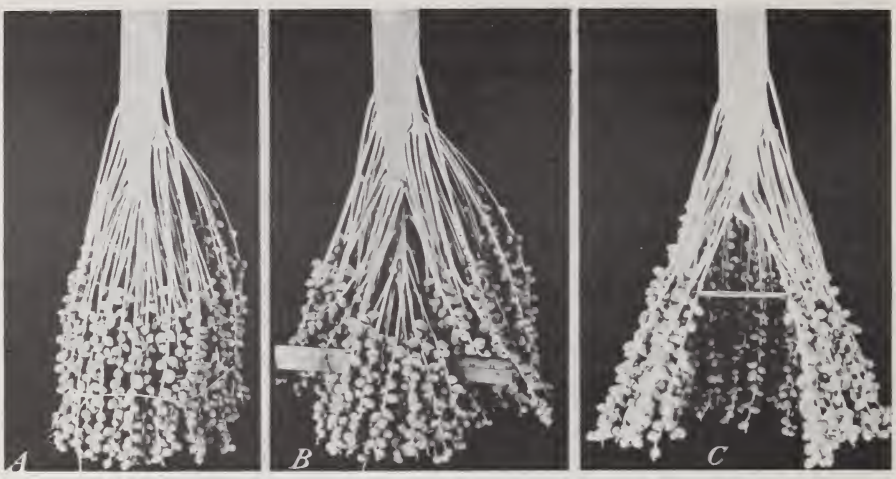

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Figure 16.—Second step in bunch thinning short-strand varieties of dates (Halawy) about 6 weeks after pollination: *A*, Bunch of dates before second step in thinning; *B*, bunch showing strands that should be removed from the center; *C*, bunch with outer strands held apart to show appearance after thinning. Half of the total number of strands were removed. If the tips had not been cut back at the time of pollination, about two-thirds of the strands should have been removed. (X about 1/9.)

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Figure 17.—Bunches of mature Deglet Noor dates that received different thinning treatments: *A*, No thinning, which resulted in small fruit below commercial size and with a large percentage of shrivel; *B*, moderate thinning, which resulted in fruit of satisfactory commercial size and very little shrivel; *C*, excessive thinning, which resulted in serious reduction in yield, oversized fruit, and a high percentage of checking and blacknose. (X 1/11.)

fruit rot and souring in large bunches than in small ones.

- Where such conditions usually prevail, it may be desirable to set an arbitrary upper limit on the size of the bunch regardless of the amount of thinning required.

In order to obtain uniform size and quality, all bunches should be thinned uniformly. After the grower has decided on the method and the proportions to be removed, the amount of thinning actually being done should be carefully checked from time to time. The total number of strands should be counted to determine how many entire strands are to be cut from the center. Likewise, if the total number of flowers on a strand of average length is counted, the tip of the strand can be cut back far enough to remove the desired percentage, and then all strands can be cut back to the same point. A difference of only 2 inches in the length of the strand tips of a large Deglet Noor inflorescence may mean the difference between one-third and one-half of the total number of flowers or fruits. Removing one-half of the flowers from the strands may result in 15 to 20 percent more blacknose than removing only one-third.

Bunch Removal

Usually entire bunches have to be removed because they are undesirable or in order to reduce the total crop. If a palm is allowed to bear too much fruit one year, it will not produce enough flowers for a normal crop the next season. The first one or two flower clusters of Deglet Noor are usually small with short strands, a long fruiting head (area from which strands branch), and a long, slender fruitstalk. Excess bunches are commonly removed in favor of the larger and later ones. On the other hand, the last few flower clusters that appear are often so small that they are left unpollinated and are removed later. When they are pollinated, the fruit is normal, but when the number of larger bunches is sufficient to carry all the fruit that the palm should bear, it is not economical to pollinate, thin, and bag small bunches with less than 6 or 8 pounds of fruit. Bunches with very poor sets or with broken fruitstalks should also be removed.

The amount of fruit that a given palm can safely carry depends on the age, size, vigor, and variety of the palm and the number of good green leaves that it carries. A large offshoot may begin flowering the year after planting, but it is not good practice to leave any fruit for the first 3 years, as growth is more important than fruit production until the palm is well established. If the young palm is making normal growth, one or two bunches may be left the fourth year, and commercial production may begin the fifth year with three or four bunches and a total of 30 to 50 pounds of fruit. Production should increase yearly until the maximum number and size of leaves are reached, usually in 10 to 15 years, depending on the variety and growing conditions. The number and the size of the leaves are the best index of palm vigor and fruiting capacity, and differences in this respect explain

some of the differences between varieties as regards yield.

With some fruits, it has been possible to work out leaf-fruit ratios that are helpful to the grower in estimating the crop that may be matured satisfactorily by a given tree. For the date palm, this is complicated because the value of the leaf to the palm declines with age and no two leaves are the same age (*4, 88*).

In studies made with Deglet Noor palms, leaves 4 years old were only about 65 percent as efficient in photosynthesis as leaves 1 year old (*98*). However, without attempting to evaluate individual leaves, Deglet Noor palms in full production and pruned to 100 to 120 leaves (4 to 5 years' growth) have been able to carry one moderately thinned bunch of fruit for each 8 or 9 leaves without reducing the number of flower clusters the following year. On this basis, the safe load for such palms would be in the range of 12 to 15 bunches, perhaps 2 or 3 more if the palms are exceptionally vigorous and the leaves larger than average.

Records from some of the better commercial date gardens show yields from healthy palms in full production of about 2 pounds, sometimes as much as 3 pounds, of fruit per leaf. If the bunches have been thinned by removing a certain proportion of the total number of flowers or fruits, an estimate of the total load by the leaf-bunch ratio method has the advantage of allowing for differences in size and vigor of palms. If the palm and leaves are small, the flower clusters are also smaller, so that there will be an approximate adjustment to the actual leaf area.

In attempting to estimate the crop that a palm should carry, a word of caution is necessary. Irrigation, fertilization, and probably other factors also affect fruit production. Although experimental data are as yet insufficient to evaluate these factors fully, there is considerable evidence that insufficient water may reduce the number of flower clusters and limit the bearing capacity of the palm regardless of the leaf-fruit ratio. Furthermore, palms that are underirrigated throughout the year will usually carry a smaller number of leaves because of the premature death of the older leaves. Since the grower naturally wants the highest yield of fruit consistent with prevailing standards of quality, individual palm records should be kept of the total number of flower clusters produced and bunches carried each season. A decline in flower production is usually evidence that either the number of leaves or the water supplied to the palm during the preceding season was not adequate for the crop carried. On the other hand, an increase in the number of flower clusters produced would be justification for leaving more fruit on the palms than had been carried the previous season.

Because of their symmetrical arrangement, the total number of leaves on a date palm can be quickly estimated. They are grouped in 13 nearly vertical columns, on some palms spiraling slightly to the left and on others to the right (fig. 18). The number of leaves in one of these col-

umns multiplied by 13 gives the approximate number of leaves on the palm. To allow for uneven pruning at the base, counts may be made on opposite sides and divided by two.

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Figure 18.—Trunk of date palm, with white tape marking 1 of the 13 spirals in which leaves are arranged.

PULLING DOWN AND SUPPORTING THE BUNCHES

After the pollination season, the bunches of most commercial varieties are pulled down through the leaves, and the fruitstalk is tied to the midrib of one of the lower leaves. This prevents much scarring of the fruit and lessens the later danger of fruitstalk breakage by supporting the bunch as its weight increases. Some of the smaller and later bunches will not be out far enough to tie when the earlier bunches are ready for this operation, but they can be tied 3 or 4 weeks later, when it is desirable to adjust some of the first ties to accommodate further elongation of the fruitstalk or movement of the bunch. The second part of bunch thinning—cutting out center strands—is usually done when the bunches are pulled down.

Pulling down bunches should be done with care to avoid breaking fruitstalks. Bunches should not be pulled down until the fruitstalk is long enough to permit some of the curvature to be distributed, so that the base will not take all the stress. If it is not done until after the fruitstalk has entirely ceased elongation, there appears to be more danger of breakage. Broken fruitstalks are an obvious loss, but partial breaks are often an unsuspected source of shriveled or low-grade fruit. The fruitstalk grows rapidly for the first few weeks after pollination. During this time, it

is rather pliable and is easily bent at the base.

A procedure followed by some growers, and one safer for miscellaneous varieties, is to start to pull down the earlier bunches from time to time while pollinating the later ones. If once or twice during the early growing period the fruitstalk is pulled down as far as possible without danger of breakage, most bunches with long fruitstalks will later come down satisfactorily even though they are not tied down. The few bunches that seem likely to give trouble in this respect may often be held down by attaching one end of a date leaflet to the fruitstalk. The bunch does not usually require support until the fruit has attained about three-fourths of its full size. With some varieties "tying up" at this time may be more satisfactory than "tying down" at an earlier stage.

With young palms, bunches are held off the ground by attaching the fruitstalk to one end of a wooden stake.

FRUIT GROWTH IN RELATION TO DAMAGE FROM RAIN AND HIGH HUMIDITY

Arabs distinguish four stages in the growth and ripening of the fruit—kimri, khalal, rutab, and tamar—that are important in relation to damage from rain and high humidity. In the first stage (kimri), the fruit grows most rapidly and is distinguished by its green color. Fruit enters the khalal stage when it has about reached its maximum size and the green of the growing period is replaced by a shade of red or yellow or a combination of the two colors characteristic of the particular variety at this time. Fruit enters the rutab stage when the tip first begins to soften or lose its khalal color. When the fruit has fully ripened and has dried until it will keep without spoiling, it is in the tamar (cured) stage.

Occasional wet weather appears to have little effect on the fruit during the early growing stage. Periods of high humidity immediately before the khalal stage, while the fruit is just beginning to fade a little in transition but still green, often cause minute superficial breaks, or checks, in the skin. The abundance of these checks and the manner in which they occur (transverse, longitudinal, or irregular) vary in the different varieties. In some varieties, such as Deglet Noor, checking occurs chiefly near the tip of the fruit, and when severe it is usually followed by a darkening and shriveling of the tip, known as blacknose (*5, 52, 77*, 78).

After the fruit acquires the khalal color, checking no longer occurs. In this stage, contact with water produces deeper and longer breaks or cracks in the skin and flesh beneath. This cracking is more severe when it occurs in the last part of the khalal stage. It is then sometimes called splitting. In some varieties, such as Deglet Noor, severe cracking is accompanied by irregular curling back of the skin and outer flesh, known as tearing. If tearing is not excessive, the torn part may return to

its normal position when dry weather follows rain, but the grade of the fruit is lowered. Humid weather during the khalal stage also favors the development of various fungi that attack the fruit and cause serious spoilage from rot.

After the flesh softens in the rutab stage, the skin does not break readily upon contact with moisture, but the fruit absorbs moisture and tends to become sticky, less attractive, and more difficult to handle. The increase in moisture content and the interference with normal drying, or curing, are conducive to fermentation and souring, which are often sources of considerable loss.

After the tamar stage is reached, rain and high humidity cause little damage to the fruit unless it is neglected after prolonged contact with water and excessive absorption of moisture.

PROTECTING THE FRUIT FROM RAIN

With most varieties and in most districts, it has been found desirable to protect the fruit from rain by covering the bunch during the ripening season. In Coachella Valley, the paper bags or tubes formerly used have been largely replaced by sheets of light-brown kraft paper. The sheet is wrapped around the bunch and tied to the fruitstalk; the lower end is left open. With varieties that have a relatively open crown, such as Khadrawy and Halawy, white paper covers have been found to cause less sunburn than brown paper covers (*87*, *97*). In the Bard district, Medjool bunches are usually covered with a lightweight white cotton bag, the upper portion of which is waterproofed.

Covers are usually put on after the fruit begins to acquire its khalal color.

Covering the bunches before the khalal stage may increase checking and blacknose since it affords no protection from atmospheric humidity but rather serves to increase it by reducing ventilation within the bunch. However, after the covers are attached, the sides may be turned under and rolled up so as to allow free air circulation about the fruit until rain threatens, at which time they should be pulled down. This is not often practicable on account of the labor involved, except with young palms or small plantings.

The importance of bunch ventilation increases with the frequency of showers and periods of high humidity during the later stages of fruit growth and ripening. Under such conditions, it is safer to use a cover flared out and not extending down around the sides of the bunch, although it may be necessary to protect the bunch beneath with a good grade of porous cloth or netting that will exclude birds and insects but at the same time not interfere seriously with ventilation. Bunch thinning promotes better aeration of fruit under covers, especially when most of the thinning is done by removing center strands.

Rings, or spreaders (fig. 19), made of heavy wire are sometimes used to keep the centers of the bunches open

as the fruit becomes full sized. To be of any value in reducing blacknose and checking, the rings must be inserted before the fruit reaches the khalal stage. They also help later in reducing fermentation and rot in the centers of bunches (*17*). Although not yet used extensively enough to be standardized, rings vary from 6 to 12 inches in diameter. Those of a many-pointed star shape seem to remain in place better than circular ones.

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Figure 19.—A bunch of Barhee dates, showing wire spreader that serves to provide ventilation in the center.

WHEN TO PICK DATES

As all the dates on any one bunch do not ripen at the same time, it has been the practice to make several pickings to harvest the fruit during a season, which lasts from 3 to 4 weeks for early maturing varieties to 2 or 3 months for late ones. Dry dates like Thoory and the semidry variety Zahidi are left until all the fruit is fully ripe, and then the entire bunch is cut. There is also a growing trend with Deglet Noor to harvest by cutting entire bunches after all the fruit is ripe, and then the drier fruit is softened by hydration.

For handpicking, the stage of maturity at which fruit is picked depends on local weather conditions, consumer preference, and variety. Where or when the climate is favorable, the fruit of most varieties should be left on the palm until it reaches the stage of maturity at which it is to be consumed or stored. From the consumer's standpoint, the fruit may be considered ripe when it becomes palatable. Actually, the changes associated with ripening and the period during which fruit may be consumed extend from the peak of the khalal stage, when the fruit has its most intense red or yellow color and maximum weight, to the final tamar stage, when it has lost the greater part of its moisture content and will keep without special attention to storage. Arabs eat large quantities of dates and many varieties in the khalal stage. At least two varieties of dates imported into the United States—

Barhee and Braim—are so palatable in this stage that even here some people, if given the opportunity, might acquire a taste for them. However, most varieties are entirely too astringent in the khalal stage for the American or European palate.

Loss of astringency is associated with loss of khalal color. Loss of moisture also begins at the same time but continues through to the tamar stage unless checked by high humidity, either as the result of atmospheric changes while the fruit is still on the palm or as affected by the temperature and the container in storage. Many people find the fruit very appetizing immediately after the loss of the khalal color, while it is still plump and the moisture content very high. However, fruit in this condition is difficult to handle and if it is to be marketed, it must be either consumed immediately or placed in storage at a very low temperature. For dessert purposes, most people prefer dates after they have passed this plump ripe stage.

The most desirable stage of maturity for consumption varies with the variety. The fruit of some varieties and of many seedlings contains such a high percentage of moisture that if dried sufficiently to keep without low-temperature storage, little substance would be left. Furthermore, some varieties ferment and sour more readily than others. To put the fruit on the market in just the proper condition is the problem of both grower and packer. With the better kinds of soft dates, the best keeping quality is attained when the fruit has lost its watery consistency and has become pliable to the touch but not tough.

With miscellaneous seedling palms or in any locality where dates have not been previously tested, the stage of maturity at which the fruit should be picked, either for immediate consumption or for storage, can be determined only by observation and experimentation.

HARVESTING METHODS

For picking soft dates, which require more care in handling than the firmer types, shallow trays should be used, and the fruit should be not more than two or three layers deep to avoid crushing and bruising. The firmer or semidry varieties may be put in deeper containers. Bins 47 by 47 by 18 inches that can be palletized have been used.

Picking becomes a problem as palms become older. Ladders of increasing length are used as the palms grow taller. Extension ladders of lightweight metal (aluminum) are favored for palms over 25 or 30 feet high. Some growers simplify the problem of carrying very long ladders around to reach extra high palms by attaching a straight ladder permanently to the trunk to cover the 10 or 20 feet immediately below the crown.

After reaching the crown of the

high palm, the laborer commonly uses a picking belt or saddle. A chain passed around the bases of three or four green leaves and attached to the belt holds him suspended beneath the leaves while he braces his feet against the trunk of the palm and picks with both hands (fig. 20). Movement around the palm has been facilitated recently by substituting a large steel hook with a long handle for the upper part of the chain. The handle is welded to the lower part of the chain, which is attached to the belt, and the hook is placed over one of the upper green leaf bases to support the picker. A second chain is placed loosely around a few of the lower green leaf bases to check the fall of the picker if the first support fails.

New systems for harvesting fruit mechanically have been developed and are commonly used for harvesting semidry date varieties, especially Deglet Noor and Zahidi. These varieties are well adapted to

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Figure 20.—Harvesting dates, showing picking belt in use.

this type of handling and can be harvested in one or two "bunch harvests" (*115*). Mechanical harvest involves delay until most of the fruit on bunches is mature and on removal of whole bunches by an operator in a man-positioner. The fruit is removed from the bunch by a mechanical shaker and is run through a separator into pallet bins. The bins are transported to a bulk storage area where the fruit is held until it goes into the packinghouse.

The system that thus far has proved most practical and has been most widely used consists of hydraulically operated towers to raise men to the level of the bunches and lower the bunches to shakers on the ground. Various types of towers locally adapted from machinery developed for tree pruning and servicing electric powerlines have been used. This machinery is expensive and requires many acres to justify its use. Small growers who wish to harvest their fruit mechanically will need to form cooperatives or resort to custom harvesting.

PACKINGHOUSE MANAGEMENT

In commercial date areas, the fruit of most growers is handled either through a cooperatively owned packinghouse or by special arrangement with a privately owned plant. The grower who plans to handle his own fruit will find it to his advantage to visit the larger date packinghouses and study the equipment and machinery used. Only brief mention of the essential operations can be given here, together with a few suggestions, included primarily for the owners of small plantings located some distance from an established packinghouse. The preparation of dates in any quantity for market includes the following steps, usually in the order given: Fumigation, cleaning, grading, artificial ripening, dehydration, hydration, packing, and storing (*34, 115*).

Fumigation

The fruit is taken to the packinghouse and fumigated as soon as possible after it has been picked. The fumigating room is generally provided with two openings to permit the transfer of fruit from an outside receiving room or platform to the main part of the packinghouse without danger of reinfestation by insects. Special construction and equipment are necessary to make the fumigation room gastight, to maintain effective temperatures, to provide for the introduction and circulation of the fumigant and its subsequent expulsion before the room is reopened, and especially to safeguard the workers against exposure to the gas (*8, 56, 133*). All outside openings of the packinghouse should be provided with screens having not less than 36 wires to the inch in order to protect the fruit after fumigation.

Methyl bromide has generally replaced other fumigants (*7*). It is used at the rate of 1 pound per 1,000 cubic feet with an exposure of 12 hours. The temperature must be over

60° F for efficient fumigation. Carbon disulfide, cyanide, ethylene oxide, and a mixture of ethylene oxide and carbon dioxide have been effective in controlling insects, but they have been abandoned in most packinghouses because of dangers involved in handling them.

Methyl bromide is a very poisonous gas and should be handled with extreme caution and only by responsible persons who are thoroughly familiar with fumigation practices. The fumigation room should be so located that direct outside ventilation can be provided for the removal of the toxic gas.

Cleaning

Dates may be cleaned by passing them over damp toweling. Mechanical shakers lined with toweling and sloping toward one end are often used for the semidry and firmer soft dates. In some types of equipment, the dates first pass over a coarse screen through an air suction, which draws off dust, dirt, and debris. The larger packinghouses have machinery to clean the fruit more thoroughly by passing it through water sprays, roller brushes, and warm, drying air currents.

Trays lined with toweling and operated by hand can be used for small lots of fruit. Dates are sometimes cleaned by being spread in a thin layer on screen-bottom trays and sprayed with water, but they must be dried promptly afterward to prevent souring. Compressed air applied with a hose has been used to blow dust from wrinkled dates (*23*).

Grading

Grading is necessary to remove culls and to separate the fruit into lots of uniform ripeness, consistency, size, and appearance for further handling. In the larger packinghouses, a moving belt conveys the fruit from the cleaner and facilitates sorting by the graders (fig. 21). Small lots of fruit, particularly the soft varieties, are often graded on tables.

Artificial Ripening

Because of unfavorable weather or a consumer preference developed under such conditions, some fruit may be picked before ripening has progressed far enough to be completed without artificial heat. For such fruit, maturation rooms are provided, where uniform temperatures from 80° to 120° F can be maintained with some provision for humidity control (*1, 7, 11, 43, 54, 55, 117, 132*).

The higher temperatures with higher relative humidity are required during ripening for the less mature fruit, which usually retains some khalal color. Nearly ripe fruit, which has little or no trace of khalal color but retains some unsoftened flesh around the seed and at the base, may not require artificial heat when temperatures of 80° to 100° F prevail early in the season. From several hours to several days may be necessary to complete ripening, longer periods being required when the fruit is less mature and the temperature is lower. The higher the ripening temperature, the darker the fruit is likely to be. Deglet Noor fruit is picked

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Figure 21.—Grading dates in a modern date packinghouse. (Photographed by Field Studios.)

after practically all the khalal color has disappeared, and in the maturation room it should not be exposed to temperatures above 95°.

Because of the great difference in time of maturity and moisture content between varieties of dates and between lots of the same variety picked under different seasonal conditions, it is not possible to outline any general procedure of ripening that will not have to be continually modified according to the experience and judgment of the operator.

For suggestions on handling small lots of fruit, see Ripening Fruit at Home, page 43.

Dehydration

Dates with a very high moisture content must be dried unless they are to be consumed immediately or placed in low-temperature storage. The maturation room may also be used for drying if provided with ventilators and equipment for expelling the moist air and circulating drier air from outside.

Small lots of dates are often dried satisfactorily in any dry, well-ventilated room by being placed in shallow screen-bottom trays, which are stacked so as to provide air movement between and around the trays.

In clear weather, such fruit may be handled outdoors if protected from insects.

Soft dates that are to be stored for any length of time at ordinary room temperature must be dried until the flesh loses its watery consistency and the fruit becomes wrinkled and raisinlike.

Hydration

Delayed picking, inadequate irrigation, or an unusually hot, dry season may cause a certain proportion of the firmer types of dates to become too dry to suit consumer preference. Since the fruit readily absorbs moisture from a humid atmosphere, packers take advantage of this fact to improve the consistency of some of the drier dates—a process called hydration (*10, 110*). When the fruit needs only a moderate amount of added moisture, it is sometimes briefly immersed in water at room temperature under conditions controlled to favor infiltration. High temperatures accelerate moisture absorption. In commercial packinghouses, special processes in which steam is used for hydration have been developed.

Small lots of dates that require only slight softening may be hydrated by being dipped in or sprinkled with water and then put in tightly covered jars or other containers for a day or so.

Packing

Dates are packed in containers according to market and trade demands. Much of the firmer bulk fruit is packed in 15-pound lugs and the soft type, in shallower 10-pound flats. The trend recently has been toward packing an increasing proportion of the crop in small packages and cartons from 8 to 12 ounces to 1, 3, and 5 pounds.

If the moisture content has been lowered sufficiently to prevent souring, dates may be kept in tight cans, glass jars, or other moisture-proof containers, which will exclude insects and prevent further drying. Cardboard and light wooden containers are used satisfactorily for fruit of higher moisture content.

Storing

Only fruit that has been properly dehydrated can be kept for any length of time without refrigeration (*9, 54, 113, 117*). The higher the moisture content of the fruit, the more perishable it is. The lower the storage temperature, the longer the fruit can be held without deterioration. Freshly ripened dates that begin to show some deterioration after several weeks in a household refrigerator at about 40° F have been kept for a year at—30° with no apparent change.

Deglet Noor dates with a moisture content of about 25 percent may be kept satisfactorily in commercial storage at 32° F for 5 to 10 months, the length of time depending on the initial condition of the fruit. Dates may also be preserved by canning according to standard procedures followed with other fruits.

To maintain a given percentage of moisture in the fruit, there must be

some control over the relative humidity of the atmosphere to which it is exposed in storage. The relative humidity required to prevent loss or gain must be raised as the temperature is lowered, and for the same moisture content of fruit it must be somewhat higher for a cane sugar date like Deglet Noor than for an invert sugar date like Khadrawy. For example, fruit may be maintained at a constant moisture content of 25 percent if at the following temperatures the relative humidity is varied approximately as indicated: At 75° F, 75 percent for Deglet Noor and 70 percent for Khadrawy; at 32°, 87 percent for Deglet Noor and 83 percent for Khadrawy. Charts have been made to show this relationship and to facilitate calculations (*112*).

The appearance of the fruit of many varieties in ordinary storage is often marred by the formation of sugar spots beneath the skin and within the flesh. Fruit has been found to sugar spot much more when the moisture content is between 22 and 33 percent than when it is either above or below this critical range (*109*). Sugar spotting may be delayed or prevented entirely by sufficiently low temperatures.

RIPENING FRUIT AT HOME

In many localities from southern California to Florida, there are a few date palms in the home garden or yard. The fruit from such palms may often be utilized, but it must be handled with improvised facilities at home. Outside the commercial date districts of California and Arizona these palms usually will be of seedling origin, and the owner should remember that the fruit will not be exactly like that of any other date palm. The best way of handling the fruit will have to be determined by experimentation and will depend to some extent on its texture, time of ripening, and reaction to rain and high humidity. Wherever and whenever the climate is warm and dry enough, the fruit should be left to complete ripening on the palm, as the best quality is obtained in this way and less labor is required. However, when showers are likely to occur during the ripening season or when fall temperatures become too low, it may not be advisable or possible to leave the fruit on the palm until it is fully ripe. The following suggestions are offered as a basis for experimentation.

Satisfactory results are sometimes obtained by cutting the entire bunch and hanging it in a relatively warm, ventilated room screened from insects and rodents. If as much as 10 percent of the fruit of certain types of dates has already ripened before the bunch is cut, a much larger proportion of the fruit will ripen later and can be picked as desired. This procedure is often followed in southwestern Texas (*136*).

If the fruit cannot be handled by the bunch method, ripening may usually be completed off the palm if the dates are picked individually as they begin to soften at the tip. Small lots

of such fruit may be completely ripened with a few days' exposure to the sun when they are placed either in glass jars with the lids loose or in trays screened to exclude insects.

For better control in handling, it may be desirable to construct a maturation box with glass or Cell-o-glass for the top and screened ventilators on the side to permit some regulation of the sun's heat (*54*). The fruit should be placed in shallow layers in screen-bottom trays, which should be raised a little so as to permit circulation of air about the fruit. Until the fruit has completely softened, the humidity should be kept high by regulating the ventilators. If additional humidity is needed, it may be supplied by placing a shallow pan of water in the box, by hanging wet cloths near the fruit, or by adding water to the air with a hand sprayer. Ripening dates in this way may require from 1 to 8 days, depending on the maturity of the fruit at the beginning and on temperatures during treatment. If the temperature within the box during the day exceeds 120° F, partial shade with muslin cloth or similar material should be provided. An old blanket placed over the box at night will help to retain the heat.

Controlled heat from any source may be used. Where electricity is available, maturation boxes or cabinets may be constructed so as to use the heat from either electric bulbs or small heating units, regulated to provide temperatures from 100° to 125° F. The oven of an electric stove may be used if the temperatures are carefully watched and regulated. Unless there are accurate thermostat controls for maintaining temperatures below 125°, it is preferable to preheat the oven to a somewhat higher temperature, then turn off the heat, put the fruit in, and allow the oven to cool. Fruit should be placed in a single layer on wire trays or cooky sheets. If the flesh is not completely softened by the first heating, the trays should be removed, the oven preheated again, and the process repeated. Two or more treatments may be required. A temperature of 200° or "low heat" is recommended for preheating in Arizona (*104*).

Small dehydrators have been designed for home use. They are very satisfactory and may be used for both maturation and dehydration by providing for increased humidity and temperatures before the fruit has softened. At the end of the dehydration process, if the fruit has not been previously fumigated, the temperature is sometimes raised to 150° F for 1/2 to 1-1/2 hours to destroy any insects or their eggs that may be present (*123*). As temperatures above 150° are likely to affect the flavor adversely, it is well to use thermometers and check them from time to time.

COMPOSITION OF DATES

The dry flesh of the ripe date contains about 75 to 80 percent sugar. In most varieties, including nearly all the soft dates, this sugar is almost entirely of the invert type (glucose and fructose). In some dry and

semidry varieties, of which Thoory and Deglet Noor, respectively, are outstanding examples, there is a relatively high proportion of cane sugar (sucrose). From the analyses available, it appears that on a dry basis there is as much variation in percentage of total sugar within a variety as there is among varieties. However, there are characteristic differences among varieties as to size of fruit, percentage of moisture, and, consequently, total amount of sugar per date.

The flesh of dates with a moisture content of 20 percent contains 60 to 65 percent sugar, about 2.5 percent fiber, 2 percent protein, and somewhat less than 2 percent each of fat, mineral matter, and pectic substances. Such fruit will furnish about 1,430 calories per pound. The nutritionally important elements in the mineral constituents are present in sufficient quantities to classify the date as a good source of iron and potassium and a fair source of calcium, but a poor source of phosphorus. There are also moderate quantities of chlorine, copper, magnesium, and sulfur. Dates contain small amounts of vitamins A, B1, and B2 and are a good source of nicotinic acid, but they contain only negligible quantities of other vitamins (*19, 26, 52, 101, 111, 116, 134*).

USE OF PESTICIDES

This publication is intended for nationwide distribution. Pesticides are registered by the Environmental Protection Agency (EPA) for countrywide use unless otherwise indicated on the label.

The use of pesticides is governed by the provisions of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended. This act is administered by EPA. According to the provisions of the act, "It shall be unlawful for any person to use any registered pesticide in a manner inconsistent with its labeling." (Section 12 (a) (2) (G))

EPA has interpreted this section of the act to require that the intended use of the pesticide must be on the label of the pesticide being used or covered by a Pesticide Enforcement Policy Statement (PEPS) issued by EPA.

The optimum use of pesticides, both as to rate and frequency, may vary in different sections of the country. Users of this publication may also wish to consult their Cooperative Extension Service, State agricultural experiment stations, or county extension agents for information applicable to their localities.

The pesticides mentioned in this publication are available in several different formulations that contain varying amounts of active ingredient. Because of this difference, the rates given in this publication refer to the amount of active ingredient, unless otherwise indicated. Users are reminded to convert the rate in the publication to the strength of the pesticide actually being used. For example, 1 pound of active ingredient equals 2 pounds of a 50-percent formulation.

The user is cautioned to read and follow all directions and precautions given on the label of the pesticide formulation being used.

Federal and State regulations require registration numbers. Use only pesticides that carry one of these registration numbers.

USDA publications that contain suggestions for the use of pesticides are normally revised at 2-year intervals. If your copy is more than 2 years old, contact your Cooperative Extension Service to determine the latest pesticide recommendations.

The pesticides mentioned in this publication were federally registered for the use indicated as of the issue of this publication. The user is cautioned to determine the directions on the label or labeling prior to use of the pesticide.

DISEASES AND PESTS

In the United States, no diseases or insect pests of the date palm have reached serious proportions so far as the industry as a whole is concerned. Nematodes are generally present on date palms, but their effect on bearing trees is unknown. In some years in the Coachella Valley, fruit beetles have caused considerable damage. The parlatoria date scale (*Parlatoria blanchardi* (Targ.)), probably the most dangerous insect enemy of the date palm, was introduced with early importations of offshoots and for a time seemed to threaten the future of the industry, but it is now believed to have been completely eradicated by Federal and State agencies (*20*). No considerable damage from any of the other insects mentioned in this bulletin is likely to occur unless control measures are neglected. A comprehensive review of date pests and diseases was published in 1968 (*38*) and should be consulted in addition to the references given under individual headings in this section.

Diseases

Fruit Rots

Fruit rots often cause considerable loss when humid weather occurs during the ripening season. Under such conditions, various fungi may develop on the fruit and cause spotting, dropping, and rotting (*41*). Damage may be reduced by good ventilation of the bunches and by protecting the fruit from rain. (See p. 35.) In addition, the hazard of fruit rots can be further reduced by dusting the bunches during the late khalal and rutab stages with one or more applications of a mixture of 5 percent ferbam, 5 percent malathion, and 50 percent sulfur, the commonly recommended fungicide-insecticide mixture (*18, 21, 31*). The maximum application of ferbam should not exceed 1.9 pounds per acre or be applied within 7 days before harvest. Where humid weather occurs rather regularly during the fall, growers in certain districts avoid some loss by

picking dates just before they are fully mature and allowing them to ripen in warm maturation rooms.

Blacknose

Blacknose (fig. 22) is a physiological disorder of date fruit that mars the appearance and lowers the grade of fruit and may produce a certain percentage of culls. This disorder is especially important in Deglet Noor, the principal California variety. The occurrence of blacknose is related primarily to seasonal conditions resulting in high humidity when fruit is in the late green (kimri) stage, which coincides with attainment of maximum size. Excessive soil moisture during this period and increased humidity around the fruit from any cause will aggravate the condition. Hence, interplantings and even cover crops and tall weeds increase the amount of blacknose unless the bunches are well above the top level of the interplantings. Checking and blacknose may be reduced by providing better ventilation of the bunches and by avoiding overthinning. (See p. 31.) Typical blacknose occurs in only a few varieties other than the Deglet Noor. For further information, see p. 34.

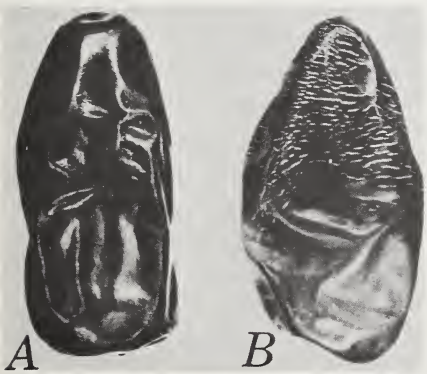

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Figure 22.—Normal Deglet Noor fruit (*A*) compared with fruit affected with blacknose (*B*). (X 1.)

Black Scorch

Black scorch is a fungus disease caused by *Thielaviopsis paradoxa* (De Seyn.) Hoehn. (=*Ceratocystis paradoxa* (Dade) C. Moreau, perfect stage) (*41*). It does most damage to young palm leaves, which become stunted, distorted, and blackened as though scorched by heat. Inflorescences and fruitstalks appearing among the diseased leaves will also be affected by the fungus. In rare instances, this fungus may cause the terminal bud of the palm to turn and grow laterally, but usually within 3 or 4 years normal vertical growth is resumed. In the United States, typical black scorch symptoms have appeared most often on the Thoory variety. Usually the disease develops only on an occasional palm, which generally outgrows it. Because of its rare occurrence, no treatment has been developed for the prevention or control of black scorch, but if there is reason to anticipate an infection of inflorescences, Fawcett and Klotz (*41*) suggest that all diseased parts be removed and burned and that dry powdered bordeaux be applied to the affected area and between the leaf bases before the spathes appear.

Graphiola Leaf Spot

Graphiola leaf spot, or false smut, is caused by *Graphiola phoenicis* (Moug.) Poit., a fungus that attacks the leaves, forming numerous small

dark-brown or black cylindrical elevations, from which yellow spore dust escapes (*42*). Severe infections may adversely affect the growth and fruiting of the palm by causing early death of leaf tissue. However, this disease is not of economic importance in the date-producing districts of California and Arizona, apparently being held in check by low humidity. In southwest Texas, where infections are more severe, bordeaux spray has been beneficial (*137*). Some varietal resistance to Graphiola leaf spot has been reported (*93, 118*).

Omphalia Root Rot

Omphalia root rot is a minor disease caused by two related fungi—*Omphalia pigmentata* Bliss and *O.tralucida* Bliss. According to Bliss (*16*), infection by these fungi results in rotting and abortion of the roots, followed by loss of vigor, stunting, and eventual failure to fruit. Only Deglet Noor palms appear to be seriously injured by the fungi. Kenknight (*61*) later reported that the *Omphalia* fungi are widespread on the roots of date palms in California and on many palms and in many gardens where growth and fruiting are entirely normal, and that it is unsafe to assume that any orchard is wholly free from these fungi. He found that some palms previously diagnosed as in a condition of decline because of omphalia root rot recovered after improved cultural treatment, and that the symptoms are commonly associated with inadequate irrigation or failure to get sufficient water penetration in tight soils.

Diplodia Disease

Diplodia disease is caused by *Diplodia phoenicum* (Sacc.) Fawc. & Klotz, a fungus that sometimes affects leafstalks and offshoots of date palms. The leaves develop dull reddish- or yellowish-brown streaks in the midrib and the offshoots may die. It is seldom found in well-cared-for gardens (*41*). Infected leaves and dead tissues should be removed. Treatment of cut surfaces with benomyl is recommended in Israel (personal communication). Pruning tools may be disinfected by dipping them in a formalin or bleach solution after each palm is treated.

Black Scald

Black scald is a name applied to areas at the tip or on the sides of dates that appear blackened and sunken as if the fruit had been exposed to extreme heat. There is usually a definite line of demarcation between the normal and the collapsed tissue, and the latter generally has a somewhat bitter taste. The cause is not known. The disease is commonly associated with some checking and blacknose, but it does not appear to be due to the same cause.

Crosscuts, or transverse notches, sometimes occur in fruitstalks. These are usually abrupt, smooth breaks in the tissue in the lower part of the fruitstalk as though it had been cut with a sharp knife. Fruit on that part of the bunch in line with the crosscut is usually stunted and of poor quality. Often the fruitstalk breaks because of this weakness, and all the

fruit may become shriveled and worthless. The cause of crosscuts in fruitstalks and of the very similar V-shaped notches often seen in leaf bases is not known. Bliss (*15*) found that affected fruitstalks sometimes have internal cavities similar to the visible external breaks in the tissue. Hence, it appears that microorganisms are not the cause and that crosscuts may result from some physiological weakness or a mechanical strain in the tissue during the period of its most rapid growth. Fortunately, crosscuts in the fruitstalks do not often occur in the principal commercial varieties. They have been serious in old palms of the Sayer variety.

Rapid Decline

Rapid decline is a term that has been used to describe the symptoms of a disease of unknown cause. From time to time it is responsible for the sudden death of a few palms scattered in date gardens throughout the Coachella Valley (*60*). The symptoms, which have also been described under the name "rhizosis" (*14*), usually appear between late spring and midsummer. Vigorous palms in full production may suddenly drop a considerable proportion of the fruit when it is only one-quarter to three-quarters developed. Fruit that does not drop shrivels. An examination of the palm at this time will usually reveal a fading and wilting of the unexpanded bud leaves and a reddish-brown discoloration beginning on the pinnae of the lowest and oldest leaves. The leaves die rapidly and progressively from the lower part of the crown upward. Some of the younger center leaves die more slowly. Although bud rot is usually an early symptom, the last leaves to die are those that emerged the previous year. The disease does not appear to follow any particular pattern in its spread, but it attacks palms at random throughout the garden. Losses were serious in only a few gardens on light soil in the northwestern end of the Coachella Valley. The disease has not been seen since 1955.

Nematodes

Root-Knot Nematodes

Root-knot nematodes (*Meloidogyne* spp.) (*25*) are widely distributed in California date palm orchards, but the amount of damage caused to bearing palms has not been determined. Nematodes are moved most readily by offshoots, which, if growing below the soil line, may be infested while attached to the mother tree. Nurseries provide a second source of infestation of offshoots. Root-knot nematodes have such a wide range of cultivated and weed hosts that their control in date orchards has not been attempted.

Root-knot nematodes can attack and kill germinating date seeds and young plants (*25*), and they may seriously reduce stands and growth of young seedling palms. Fumigated soil or soil free of these nematodes is recommended for growing seedling date palms.

Mites and Insects

Banks Grass Mite

The Banks grass mite, *Oligonychus pratensis* (Banks), sometimes causes serious drying and scarring of the date surface during the growing stage (*119*). Although the mite is too small to be readily seen, its presence may be suspected from the fine, dense web with which it covers much of the fruit surface (fig. 23). The mite is readily controlled with sulfur dust, which should be applied about the last of May or the first of June (*130*). In severe infestations, a second application may be necessary a month later. Sulfur applied as a spray has also proved to be as effective as sulfur dust (*36, 37*).

BN-8094-X

Figure 23.—Typical appearance of Deglet Noor fruit in the khalal stage when seriously damaged by mites. Note dust-covered webbing and silvery areas on the skin where the mites have been feeding. Such dates will be culls when ripe. (X about 3/4.)

Fruit Beetles

Fruit beetles are the most troublesome insects during the date harvest. The dried-fruit beetle, *Carpophilus hemipterus* (L.), and the corn sap beetle, *C.dimidiatus* (F.), are the most common. These two insects are cosmopolitan. They are about one-eighth inch long, but *C.dimidiatus* usually is brown instead of black and lacks the two light spots characteristic of *C.hemipterus* . Two other members of the family Nitidulidae are less numerous—the pineapple beetle, *Urophorus humeralis* (F.), which is black and about twice as large as the other beetles, and *Haptoncus luteolus* (Er.), which is yellowish or light brown and about half as large. All four beetles have similar habits. They attack the ripe fruit, preferring soft and sour dates. The eggs are laid on or in the fruit. The larvae feed on the fruit until they are full grown and then pupate in the soil.

The beetles are killed by fumigating the fruit after it is picked but before it is stored or packed. However, since the injury and residue left by the insects will make culls of the fruit, it is important to reduce the insect population as soon and as much as possible.

Field infestation of dates by fruit beetles can be controlled with a 5-percent malathion dust, an organic phosphorus insecticide. Do not apply malathion within 7 days of fruit picking. It should be applied directly to the fruit bunches at the rate of 40 pounds per acre approximately 3 weeks before the first picking (*129*). Repeated applications may be

required (*131*). Garden sanitation is highly desirable. The treatment or removal of dropped fruit is complicated because all four nitidulid beetles also feed on waste grapefruit, sweet corn, pomegranates, figs, tomatoes, and grapes. One way to reduce the beetle population in dates is to destroy all decaying fruits and vegetables during the winter, spring, and early summer, when there are very few dates in the garden for the beetles to feed on (*65*).

Indian-Meal Moth

The Indian-meal moth, *Plodia interpunctella* (Hbn.), is seldom noticeable in the field, but it is a serious pest of dates in the packinghouse unless controlled by fumigation. The larvae are pinkish or cream colored and are larger than those of the nitidulid fruit beetles. Application in the field of a 5-percent malathion dust for control of fruit beetles will also control the Indian-meal moth (*131*).

Raisin Moth

The raisin moth, *Cadra figulilella* (Greg.), primarily a field insect, is sometimes found on dates in the late fall, especially when there are long intervals between pickings. The larvae are about the same size as those of the Indian-meal moth, but they may be readily distinguished from them by the line of brownish or reddish dots on each side of the back extending the length of the body. Development is retarded under storage conditions, but fruit should be fumigated as soon as an infestation is discovered. This insect may also be controlled in the field with a 5-percent malathion dust as applied for fruit beetles (*131*).

Saw-Toothed Grain Beetle

The saw-toothed grain beetle, *Oryzaephilus surinamensis* (L.), is likely to find its way to dates stored under ordinary conditions. It is typically a packinghouse pest. The adult beetle is about one-tenth inch long, dark brown, narrow, and much flattened, with six toothlike projections along each margin of the body in front of the wings (*119*). Periodic fumigations and well-insulated storage rooms, preferably cold storage, are the only safeguards.

Merchant Grain Beetle

The merchant grain beetle, *Oryzaephilus mercator* (Fauv.), is very similar in appearance to the saw-toothed grain beetle. It is a close relative and is found in undetermined proportions with the latter (*119*). This beetle also is readily controlled by fumigation.

Red Date Scale

The red date scale, *Phoenicococcus marlatti* Ckll., of Old World origin, occurs in all districts where dates have been planted commercially in Arizona and California. This scale attracts little attention, as it is found mostly underneath the fiber behind overlapping leaf bases, around the bases of fruitstalks, and frequently on roots underground. On the protected white tissue of leaf bases it often occurs in abundance. The individual scale is seldom larger than a small pinhead, roundish in shape, and deep

pink to dark red in color, but partly or entirely covered with a white waxy secretion that forms a cottony mass about it. On the exposed parts of the palm it is apparently unable to survive the extreme summer heat of the desert climates best adapted to fruit production. It seldom appears to cause appreciable damage to palms growing under favorable conditions. However, when experimental plantings of dates are made in new areas where the climate is milder or more humid than in the established commercial areas, the possibility that the red date scale might cause more damage should be considered.

Datebug

The datebug, *Asarcopus palmarum* Horv., one of the lantern fly family, Fulgoridae, is a small reddish-brown insect, slightly larger than a grape leafhopper. The datebug occasionally attracts attention by the considerable amount of honeydew it excretes on the bud leaves and around the bases of fruitstalks. Only rarely has it caused enough damage to warrant treatment.

Fig Beetle

A fig beetle, or a green fruit beetle, *Cotinis texana* Casey, is native to southern Arizona and occasionally does considerable damage to early ripening dates in the valleys of the Salt and the Gila Rivers. This is a large green beetle, 3/4 to 1-1/3 inches long. It is present in varying numbers from midsummer to September. The adults feed on various soft fruits and sometimes destroy entire bunches of dates. The beetles go through light cheesecloth or muslin but not coverings of strong netting. The eggs are laid under haystacks and manure piles, where the larvae feed on organic matter.

Some success has been had in combating this beetle in Arizona by placing near the ripening fruit straight-sided pail traps holding cull or rotting fruit or similar material. Cleaning up manure piles and haystacks during February, March, and April or flooding these areas for 48 hours during the egg and early larval stages in September and October is recommended in Arizona (*75*).

Fruit Wasps

Three species of fruit wasps—*Polistes apachus* Sauss., P. *annularis* (L.), and P. *exclamans* Vier.—often seriously damage date fruit in the district around Winter Haven, Tex. The only known method of preventing damage is to enclose the bunches in cloth bags before ripening.

Minor Pests

A snout-nosed butterfly, *Libythea bachmanii* Kirtland, is occasionally attracted to dates in the district around Winter Haven, Tex., and covers unprotected fruit with scales from its wings. These scales stick tenaciously to the fruit and ruin its appearance and salability.

In the lower Rio Grande Valley of Texas, date palm offshoots and nursery palms of other species are occasionally injured by the rhinoceros beetle, *Xyloryctes jamaicensis* (Drury), which bores into the palm just below the soil surface. Nurserymen in that district flood the

beetles out of their holes with water, pick them up, and destroy them. A giant palm borer, *Dinapate wrightii* Horn, is another large beetle that infests the California native fan palms in the canyons and foothills bordering the Coachella Valley. It had been known to attack a few date palms in Palm Springs, but the amount of injury has been questionable, and so far the beetle has not been found in any commercial date planting.

The fruit-bearing strands of a date bunch are sometimes damaged by a cicada, *Diceroprocta apache* (Davis), which may partly sever a strand with a row of its egg punctures. The total damage can be quite severe in isolated cases (*35*).

Protection From Birds

Many kinds of birds are attracted to dates, and they are likely to be particularly troublesome during the ripening season in localities where there are relatively few palms. The bags used to protect dates from rain also serve to reduce the damage done by birds. Soft dates, which are more attractive to birds than the semidry and dry varieties, are often protected by covering the entire bunch with cheesecloth or lightweight muslin.

VARIETIES

Selection

The commercial date industry in California and the early plantings in Arizona were developed with varieties imported originally as offshoots from the date-growing regions of North Africa and the Middle East, principally Algeria, Egypt, and Iraq. Comments on the adaptation and behavior of the varieties listed later are based on observations covering more than half a century.

Many years are required to test thoroughly a new date variety because of varying seasons and the effect that certain factors in culture and management sometimes have on successful fruit production.

The prospective date grower should give careful attention to the selection of varieties likely to succeed in his locality. Climatic adaptations are of primary importance but must be considered with reference to soil conditions, yields, and present and future markets. Unless satisfactory tests have already been made in a given locality, the conservative procedure is to make a small planting of two or three varieties and extend acreage later on the basis of their behavior as they come into bearing. Some varieties that would not be adapted to tonnage production may be handled successfully on a small scale. In all the warmer desert sections of southern California and Arizona, the fruit orchard should have at least a few date palms for home use. In such plantings, several varieties of different types and times of ripening are desirable.

Varieties of dates are generally divided into three groups according to whether the flesh of the fruit, as it

ripens under normal conditions in a favorable climate, is soft, semidry, or dry. These divisions are somewhat arbitrary, as consistency of flesh is affected by climatic conditions and methods of handling, but the classification is convenient and widely used.

The sugar of immature dates of all varieties contains a high proportion of sucrose or cane sugar. As ripening progresses, cane sugar is converted to invert or reducing sugars, but the amount of conversion is related to texture (*29*). Soft varieties, when fully ripe, contain little or no cane sugar and are often spoken of as "invert sugar" dates. The dry and semidry varieties, on the other hand, retain more or less sucrose when fully ripe. In the Deglet Noor and Thoory varieties, as much as one-third of the total sugar content may be sucrose; they are often called "cane sugar" dates. Slight differences in flavor and diet preference are associated with the two types of dates, but a difference of importance to handlers is that invert sugar dates remain soft at a lower moisture content than do cane sugar dates. As a consequence, the latter after several months may become objectionably hard unless the humidity in storage is controlled (*112*).

The varietal descriptions in the following sections are only given for those dates of current or potential importance in the domestic industry. Varieties listed in previous editions of this bulletin, but now being deleted, are: Hayany, Iteema, Khalasa, Kustawy, Maktoom, Rhars, Saidy, Sayer, and Tazizoot. Detailed descriptions of these and all other varieties that have been imported into the United States are available in another publication (*89*).

Descriptions

Barhee (bär′hē)[4]

This soft date from Iraq has been increasing in popularity, although it is represented in only a few commercial plantings in the Coachella Valley. Rain and high humidity have moderately damaged the fruit. The fruit is small to medium, ovate to nearly round, and yellow. It becomes amber on ripening and deep golden brown when cured. The fruit has relatively little astringency in the khalal stage as compared with other varieties. It ripens late. Characteristic of this variety is its heavy yield, which is frequently over 300 pounds per palm.

Dayri (dā′rĭ)

This semidry date from Iraq (*79*) has attracted some attention because of the relatively slight damage sustained by the fruit during occasional humid weather, but there are only a few palms in commercial plantings in southern California and Arizona. It is apparently best adapted to heavy soils with ample irrigation. The fruit is medium to large, oblong to oblong-elliptical, and dull rose over a deep chrome yellow. It ripens and cures to

[4] These phonetic spellings after the variety names are not exact transliterations of the Arabic but merely attempts to give pronunciations that would be recognizable in the country of origin and at the same time conform as nearly as possible to established usage in the United States.

a dark reddish brown, usually with a deeper color, almost black, at the base. The softer fruit is attractive. The drier fruit is a light dull red with a distinctive purplish tint; although usually disappointing, it is readily improved with commercial softening processes. It ripens in midseason. The yield of this variety is variable because of frequent failures to get a good set of fruit. Under favorable conditions, the yield is from 150 to 200 pounds per palm.

Deglet Noor (dĕg′lĕt-nō͞or)

This semidry date from Algeria is the leading commercial variety in the United States. It is grown chiefly in the Coachella Valley, where, in 1977, it accounted for about 85 percent of the total date acreage. In most parts of Arizona it has failed, largely because of the fruit's susceptibility to damage from rain and high humidity. However, this variety has sometimes failed because it was planted on heavy soil to which it is not adapted. The fruit is medium to rather large, oblong-ovate, and coral red; becomes amber on ripening and a deeper brown when cured; and ripens late. A yield of 200 to 300 pounds per palm is harvested under favorable conditions.

Halawy (hȧ-lä-wĭ)

This soft date from Iraq is grown in all the date-producing districts, where over a period of years it has been damaged relatively little by occasional rains and high humidity. Its principal disadvantage is a tendency to shrivel during ripening, although this objection is not usually serious when it is grown on the heavier soils with adequate irrigation. The fruit is small to medium, oblong with rounded apex, and yellow; becomes light amber on ripening and translucent golden brown when cured; and ripens early. The yield is from 200 to 250 pounds per palm.

Khadrawy (ku-draw′wĭ)

This soft date from Iraq is fairly well adapted to a rather wide range of conditions. The palm is smaller than any other commercial variety. The fruit is small to medium, oblong-ovate, and light yellowish; becomes greenish amber on ripening and reddish brown when cured; and ripens early. The yield is light, seldom more than 100 to 120 pounds per palm.

Medjool (mĕd-jo͞ol)

This soft date is from Morocco, where it was formerly the leading export variety. Since World War I, it has been threatened with extinction in Morocco because of the ravages of the bayoud disease to which it is particularly susceptible. Although classed as a soft date, it is firmer than varieties like Barhee and Khadrawy. The fruit has been only slightly damaged by occasional rains and high humidity. The fruit is variable in size but characteristically very large and broadly oblong oval to somewhat ovate. Irregularities in shape are common and are associated with ridges on the seed.

To promote uniformity and the extra large size which brings a premium on the market, this variety is usually heavily thinned by cutting out

a large percentage of the center strands and reducing the number of dates per strand by removing individual fruits by hand. The fruit is orange yellow with a fine reddish-brown stippling, becomes amber on ripening and reddish brown when cured, and ripens early. Yields are 150 to 200 pounds per palm.

Thoory (thōō′rĭ)

This dry date from Algeria is the only variety of this type planted to a very limited extent commercially in the Coachella Valley. The fruit is only slightly damaged by occasional high humidity. It is medium to large, oblong with rounded apex, and yellow; ripens and cures to a light grayish brown or straw color with apical parts frequently dull brown; and ripens late. The yield is from 200 to 250 pounds per palm.

Zahidi (zā′ĭ-dĭ)

This semidry date from Iraq is planted to some extent in all date-producing districts in California and Arizona. Growers of this variety claim that its fruit can be handled more economically than that of most other varieties, although it is generally regarded as somewhat lacking in quality. The fruit is a little less tolerant to rain and high humidity than the Halawy and Khadrawy fruit. The fruit is small to medium, obovate, and yellow; becomes amber on ripening and reddish brown when cured, except for dull-yellow or straw-colored areas of dry flesh retained at the base of many fruits; and ripens in midseason. The yield is from 200 to 300 pounds per palm.

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